DOCUMENT RESUME

ED 148 578 SE 023 291

AUTHOR	Sorenson, Juanita S.
TITLE	Measuring in Metric.
INSTITUTION	Wisconsin Univ., Eau Claire.
PUB DATE	77
NOTE	128p.: For related documents, see SE 023 286-290; Update to ED 127 113; Not available in hard copy due to copyright restrictions; Contains occasional colored pages which may not reproduce well
AVAILABLE FROM	Dr. Juanita Sorenson, University of Wisconsin-Eau Claire, Library 1109, Eau Claire, Wisconsin 54701 ($3.50)
EDRS PRICE	MF-$0.83 Plus Postage. HC Not Available from EDRS.
DESCRIPTORS	Elementary School Mathematics; Elementary Secondary Education; Individualized Instruction; *Inservice Teacher Education; Instruction; *Instructional Materials; *Mathematics Education; *Measurement; *Metric System; Teacher Education; Teaching Guides
IDENTIFIERS	*Wisconsin

ABSTRACT

Eight modules for an in-service course on metric education for elementary teachers are included in this document. The modules are on an introduction to the metric system, length and basic prefixes, volume, mass, temperature, relationships within the metric system, and metric and English system relationships. The eighth one is on developing a teaching plan and is designed to be completed in participants' own schools. Each module includes objectives, informational materials, suggested activities, and evaluation measures. References, equipment lists, additional activities, and concise summaries of metric measures are appended. (MS)

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MEASURING IN METRIC

A TEACHER'S WORKSHOP MANUAL FOR INDIVIDUALIZED INSTRUCTION

SE 023 291

Measuring in Metric

BY

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with contributions from

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OVERVIEW OF THE MANUAL

This manual has been developed to help acquaint elementary teachers with the metric system of measurement. The content of metric measurement has been divided into "modules" with each module covering a given metric subject. For example, one module deals with metric length, another volume, another mass and so on. Content is arranged so there are no metric-English conversions until basic aspects of metric measurement have been discussed. If desired, metric-English conversions (Module 7) may be omitted.

Each module has three divisions--(1) objectives; (2) suggested activities to meet the objectives; and (3) illustration of mastery. These modules were developed in the same individualized format that has been used successfully in graduate courses at the University of Wisconsin-Eau Claire. The objectives and subsequently the activities and illustration of mastery range from the behavioral-type for learning content to the expressive-type for developing a game or materials. This allows for a creative and humanistic approach to learning the metric measuring system as well as gaining a knowledge of the subject matter. The approach parallels Bloom's hierarchy of cognitive levels.

The modules allow for teachers to learn at their own rate and style and to enter the learning process according to what they already know about metric measurement. There is also provision in the modules for a variety of learning patterns--independent study, one-to-one with instructor or another adult, small group, and large group. In the culminating module, number 8, the teacher develops a plan for teaching metric measurement to the age/grade level of children he/she is working with in his/her own school. The teacher may adapt any materials or ideas from this manual including assessments, games and worksheets for his/her students. In addition, the teacher will key in available text, audiovisual and manipulative materials.

In addition to the content related to the modules, a variety of pertinent charts, scripts for a videotape puppet show and radio broadcast, numerous metric activities, a list of metric references and an equipment list are included in the Appendices.

It should be remembered that this manual will never be "finished." New materials on metric will continually come to the attention of an alert teacher and, of course, new materials will constantly be produced. Teachers will be encouraged to develop resource files for use with their students. Assessments and their accompanying keys, readings, summary sheets and worksheets are given here in their entirety. In the case of games and laboratory activities, answers, directions and ideas are presented in the manual in so far as possible. However, in several activities, items in the room are measured and measurements will vary. For some games, only one card is presented along with suggestions for how to design the other cards.

Finally, it is the intent of the authors that this manual will be only a starting point for teachers to learn metric measurement and that it will inspire them to start a program for teaching metric to their students in an individualized and exciting manner and that they will update through the years.

Eau Claire, Wisconsin
September, 1977

J.S.S.

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METRIC COURSE SYLLABUS

General Objectives

The participants will gain an understanding of the metric system in terms of (1) basic units of measurement for length, volume, weight; (2) application of basic units to daily living; and (3) development of a plan for teaching the metric system to students at the age/grade level at which they teach.

Content will be presented from simple to complex. The instructional format will be modules which allow participants to learn according to what they already know, how rapidly they learn and how they go about learning. The modules utilize a variety of grouping patterns as large group, small group, one-to-one and independent study, and are designed to accommodate a variety of learning styles.

Content has been divided into two groups:

Group A. These modules are required for all participants:

1. introduction to the metric system
2. metric length and basic prefixes
3. metric volume
4. metric mass
5. metric temperature
6. relationships within the metric system
7. metric and English relationships

Group B. This module is required and can be carried out alone or with others. It will be started during the workshop and completed after the participant has returned to his/her school (e.g., one month after the close of the workshop). Activities in this module should utilize materials available in the participant's building/system and ideas of fellow staff members.

8. developing a teaching plan

This workshop can be taken as a graduate 2-credit course. If only metric content is desired, modules 1-7 constitute a one-credit course.

INTRODUCTION TO THE METRIC SYSTEM

Objectives

The participant will be able to:

1. describe reasons for standard measurement.
2. describe briefly the history of the English and metric systems including the rationale and origin of their development.
3. indicate the basic metric units of measurement for length, volume, and mass.

Suggested Activities to Meet Objectives

1. Read "How We Got Our Measuring Units."
2. Read "Why Do We Need to Measure?" (written for elementary students)
3. Participate in "Measurement and Metric Units: Activity/Discussion."
4. Read puppet show script, "Metric in Mouseland" which is presented in Appendix A or view a film on how metric measurement will effect our daily lives.

Illustration of Mastery

1. Agreement of "satisfactory" between instructor and participant on completion of "Measurement and Metric Units: Activity/Discussion."
2. Completion of "Overview of the Metric System" posttest with 80 percent accuracy.

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HOW WE GOT OUR MEASURING UNITS

Narrative Module 1

As soon as people started to trade with each other, they had to know how much of a material they were buying and how much it would cost. They needed to measure the material so the customer would always get a correct amount and pay a fair price. The needs for more sophisticated measurements led to the development of measurement systems.

How the English System of Measurement Started

The measuring units in the system had to be something convenient -- the length of a man's arm, the spread of his fingers, or the amount of weight that he could lift. The early tradesmen picked something convenient, and then the government usually declared it to be an exact size.

The Foot and the Yard

It was common many years ago to measure length from the end of your nose to the fingertips of your outstretched arm. This, of course, was a short measurement for a boy and a long measurement for a grown man. It had to be definite. So the king declared that the length of his own arm would be the legal measure of length. He cut a wooden stick this long, which he called a "gyrd", the English word for rod. From this word came our word "yard."

Measuring on the ground was easier to do with your foot than with your arm. This measure was called a "foot" and the king decreed that the length of his foot would be the standard for all measurement in feet. It happened that the king's arm was three times as long as his foot, so the first yard was divided into three feet.

To measure distances smaller than a foot, you had to guess again. To get more accuracy, traders divided the foot into 12 parts and called each part an inch from the word "ynce", which meant a twelfth part. They could have divided it into 10 parts or 8 parts or even 100 parts, but 12 seemed practical since each inch was about equal to the width of a man's thumb.

The Acre, the Rod and the Mile

When farmers wanted to measure a field, they needed a more convenient measure than a yard stick or a foot rule. It was their practice to measure a field in terms of how much a man could plow with a team of oxen in one day. This was termed an "aecer", the old word for a fenced field. From it comes our word "acre".

Of course, this amount had great variation. Some farmers had slow oxen, others plowed during the long days of summer and measured a bigger acre than when they plowed in the short days of fall. They could plow only a small amount of land per day when the field was very stony, compared to a field without stones.

When engineers began to measure land for buildings and roads, they wanted an acre of more definite size. They created a new measurement called a "rod", about the distance between fence posts. There are 160 square rods in an acre.

Long distances for roads and streets were measured by pacing off. The Romans measured 1,000 paces which they called a "mille", the word for 1,000. The mile is still the unit for measuring long distance in many countries, and it is often different. The old Roman mile was 1,620 yards. The English and U.S. mile is 1,760 yards. A sea or nautical mile is 2,027 yards.

The Gallon and the Quart

We don't know exactly how liquid measures developed. Liquid was probably measured in a container that would hold an amount that the average man or woman could lift and carry for a distance on the shoulder or head. The wine jug became the standard for measuring liquids, and the measure was called the "galon" or "jallon", which meant a measure of capacity. For convenience in measuring smaller amounts, they divided the "galon" into quarters and called each part a "quart".

The Pound and the Ounce

There were many things that couldn't be accurately measured with a yardstick or poured into a standardized size bucket. How would you measure something like a cow or a sheep with just a ruler?

Animal measurement was important in trade and it required a new measuring unit called weight, which would account for the irregular sizes and shapes of different animals. The English developed a weight measure which they called a pound from the ancient word "pund", an animal enclosure. The pound was divided into 12 smaller units called ounces from the word "ynce" or "once" meaning one-twelfth part, the same division as for the foot.

The yard and the foot, the quart and the cup, the pound and the ounce are not the measures used in most countries of the world. In most countries outside the United States, people measure with different tools and measurements. Their measuring language is called the "metric system".

How the Metric System Started

The country where it started almost 200 years ago is France. Scientists in that country thought that there should be a better measuring standard than the length of a man's arm or the amount of water he could carry on his shoulder.

The Meter, Centimeter and Millimeter

They divided the distance around the earth into many small parts. Each part they called a "meter", the word which means measurement. You probably have seen a "meter stick" and noticed it is slightly longer than a yard stick. If you could place meter sticks end to end, 10 million of them would reach from the equator to the North Pole, one-fourth of the way around the earth.

The meter stick is divided into 100 smaller pieces called centimeters, something like the way the American dollar is divided into 100 cents. Each centimeter is divided into 10 parts and each of these parts is called a millimeter. A centimeter is a little more than the width of a pencil. A millimeter is about the thickness of the wire in a paper clip.

The Liter

The French scientists at first measured quantities of liquid in centimeters. A box 10 centimeters high, 10 centimeters wide and 10 centimeters deep would hold an amount of water they called a liter. The paper carton your milk comes in will hold about one liter, a little more than a quart. The liter is divided into smaller units called centiliters (1/100th) and milliliters (1/1000th) of a liter.

The Kilogram and the Gram

The basic unit used to measure mass or weight is the kilogram. A kilogram is 1000 grams and is about twice as heavy as a pound. The gram is useful to measure smaller amounts and is about the weight of a paper clip. A nickel coin weighs about 5 grams.

The International System (SI)*

Through several international meetings, nations using the metric system have tried to make it as uniform as possible in names of units, spelling of those names, and the kind of units considered "basic".

In 1875 forty countries agreed that the basic units should be the centimeter for length and volume, the gram for mass, and the second for time. That system, called the CGS (centimeter, gram, second) system was used until 1960.

In that year 56 countries adopted some different basic metric units. They are the metre for length and volume, the kilogram for mass, and the second for time. You will note that these are the more convenient and common units used in everyday work. This system is called the International System of Units or System International (SI).

Since the metric system is the international language of measurement for the world, it is important that everyone use the same words in this special language. The SI lists all the derived units of measurement that will be in common use in the world. It recommends spellings and abbreviations of the various units.

Not all the language of SI is uniform yet. Some countries want to hold on to familiar terms, or they want to move slowly to give people time to become accustomed to a new term.** The International Standards Organization (ISO) makes the final rulings on these matters. An international conference of ISO is scheduled for 1979.

* See Appendix C for a detailed chart and reference to an official manual on SI.
**The more traditional spellings, meter and liter, will be used rather than the SI spellings, metre and litre in this manual.

WHY DO WE NEED TO MEASURE?*

The question of "how many" comes up very early in life. You learned to hold up four fingers to show that you were four years old when somebody asked you your age. It wasn't too difficult to use the idea of "how many" to count the number of children in the group, books in your desk, puppies in the garage, or marbles in a bag.

Soon you learned to count up to high numbers, and counting worked well for anything. Five dogs, five oranges, five men, five houses are all numbers that we can agree upon even though each group of articles we count is very different from the others.

But after while you found other things that couldn't be counted. Can you say how many grains of sugar in a bag, or how many lumps of coal in a bin? You probably could count a very small quantity of sugar or coal, but you usually ask "how much" for these things. When you want to know how tall a tree is or how far it is to the next town, you have to answer the question "now much."

To do this, we go back to our old question of "how many," which is usually easy to answer--but how many "what's" in the size of a tree, the road to the next city, or a pail filled with water?

How can you tell me how tall a young tree in your front yard is? You can say it is smaller than the other trees and that it is taller than you are. This tells me something, but unless I can see you and see the other tree, I don't really know the size of this tree, do I?

Suppose your grandmother in California wants to knit a pair of socks and a pair of mittens for you, but she hasn't seen you for a long time and she really isn't sure how big the socks need to be and how much yarn she needs to buy. How could you give her the information she needs? You might trace out your hand on a piece of paper and send the paper to her. Or you might send her one of your socks that fits you.

This will work without much trouble for socks or mittens, but it becomes much more difficult when someone wants to buy you a pair of skis, which should be taller than you are. Sending a pattern of your full size is not a very good way to do it. And, of course, we don't do it this way today.

Instead, we have measurements which we make with various measuring instruments. Your mother can stretch a tape measure around your hand and from your wrist to your finger tips and write down the numbers she needs off the measuring tape. A month later your knitted socks and mittens arrive in the mail and they fit perfectly.

This is not magic, nor is it just good luck. The socks fit because they were measured with what we call a standard measurement--in this case a ruler that is 12 inches long. In any different city or even any foreign country this ruler is always the same size, though it may be made of plastic, wood, or metal.

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*Written for elementary students.

If I use this unit for measuring and send the figures to somebody to use, I am really doing the same thing as sending a pattern of the size socks I want. The measurements are a language that I can use to tell other people "how much" and we will both understand what we mean, even though we may never speak nor see each other.

The language of measurement is highly developed so we can say how much a container holds, how far away a star is, how much a material weighs, how fast a motor runs.

The terms we use to describe what we measure can be almost anything. But they must be accurate, they must be convenient, and they must be practical. By that we mean that every ruler must be exactly the same length wherever you may use it. You don't find rulers made out of rubber because they can be stretched to different lengths. They are metal or wood, which keeps its length.

To be convenient and practical, the measuring instrument should be something you can handle easily. A ruler short enough to carry in your pocket is good for measuring the top of your desk, but it is much handier to measure the length of your house with a long measuring tape that winds up on a reel small enough to place in your pocket.

Our measurements and measuring instruments have become accurate after long years of use and improvement, but some were not as convenient as others. They developed as they were needed and have been accepted as the language of business, science and everyday living.

In the early history of the world, different countries had different measuring systems. They were satisfactory as long as they traded with people who used or understood these measurements. But when trading became more common on a worldwide scale, different measuring systems sometimes caused confusion and inconvenience.

If your language of measurement is different from mine, I must translate it into a form I can understand, just as I must do in a spoken language. Changing or translating measurements takes extra time and makes errors more likely, so it would be better if all language were the same.

During the last few years all nations of the world have been moving toward the use of an international language of measurement. The United States, Canada, and England are three large countries that are changing their usual system of measurement to the international one. The world system is called metric or system international. It is abbreviated to SI. SI will make all nations able to understand each other whenever they deal with terms of measurement.

MEASUREMENT AND METRIC UNITS: ACTIVITY/DISCUSSION*

1. Why do we have standard measurements?

   a. Divide group into teams of 3-5 people and designate a team leader.

   b. Have small groups "brainstorm" (3-5 min.) where they used measurement today or yesterday.

   c. Have each team measure one side of a table or other designated object (all groups measure the same side) without any standard measuring tool(s).

   d. Have team leaders present their results to total group and instructor leads discussion to point out need for standard measurement.

2. How will the metric system affect our daily lives?

   a. View videotape or film on general effects of metric system, how it developed, and why the United States is changing to metric. (Use the puppet show script, Metric in Mouseland presented in Appendix A as a starting point or to make a videotape, or use a film such as from the list suggested under references.)

3. What's a Meter?

   a. Discussion leader presents a meter stick and asks group to name objects that could be measured with it.

   b. Divide group into teams of 3-5 people and give a meter stick to each group. Have teams measure length of room, tables, etc. in meters.

4. What's a Liter?

   a. Discussion leader presents a liter container. Indicate liter is a little larger than quart if desired. Ask group to list substances they would measure in liters.

5. What's a Gram? What's a Kilogram?

   a. Discussion leader passes out 1 gram cubes (or paper clips) to each person and indicates each cube has a mass of approximately one gram. Discuss what kinds of objects would be measured in grams.

   b. Distribute nickels to each participant. Ask them to estimate the mass of the nickel by comparing it with other available objects (e.g., gram cubes or paper clips).

   c. Instructor weighs nickel to determine its actual mass.

*This session would be led by an instructor.

OVERVIEW OF METRIC SYSTEM - POSTTEST

1. What is the basic unit of length in the metric system? 1. ____________

2. In which country did metric measurement originate? 2. ____________

3. Name the only major country that does not use the metric system. 3. ____________

4. What is the basic unit of volume in the metric system? 4. ____________

5. What is the basic unit of mass in the metric system? 5. ____________

6. A meter is _______(longer/shorter) than a yard. 6. ______________

7. A quart is _______(larger/smaller) than a liter. 7. ____________

8. Which system of measurement uses the number 10 as its base? 8. ____________

9. The gram is _______(heavier/lighter) than the pound. 9. ____________

10. Modern measurement systems have units that are always the same. These are called ____________ units. 10. ____________

METRIC LENGTH AND BASIC PREFIXES

Module 2

Objectives

The participant will be able to:

1. identify and describe the basic unit of metric length.
2. define the six basic prefixes used in the metric system and indicate the symbol for each.
3. indicate the standard symbols for the meter and six other basic length units.
4. accurately measure materials of a variety of lengths using the meter and the other six basic length units.
5. identify instances where he or she would use the meter and each of the other six units of metric length in daily living.

Suggested Activities to Meet Objectives

1. Read "Length and Basic Prefixes."
2. Study "Summary Chart on Metric Prefixes and Length Units."
3. Read the fable, "The Friendly Cloth Merchant."
4. Play the game, PREFIX CONCENTRATION.
5. Complete worksheet, "How Long Are the Kite Tails?"
6. Work crossword puzzle, METRIC LENGTH.
7. Play card game, MIX-A-METER.
8. Complete learning activities 1 and 2 on metric length.
9. Review additional games and activities on prefixes and length in Appendix B.

Illustration of Mastery

1. Participation in games, PREFIX CONCENTRATION and MIX-A-METER.
2. Agreement of "satisfactory" between instructor and participant on completion of:
   a. "How Long Are the Kite Tails?" worksheet
   b. "METRIC LENGTH" crossword puzzle
   c. "Metric Length" learning activity #1
   d. "Metric Length" learning activity #2
3. Completion of "Metric Length Unit - Posttest" with 80 percent accuracy.

LENGTH AND BASIC PREFIXES

Being introduced to a new measuring system is like meeting a new friend. First you learn his/her name so you can identify and get a general impression of what the person looks like. Later, you learn more details about him/her.

You are going to be introduced to a new friend, Mickey Metric. Mickey Metric has three dimensions -- length, volume, and mass -- which together make up his total character or "personality".

In this first meeting, you will get your first impression of Mickey Metric, which is the measurement of length. After getting well acquainted with length, you look at volume and mass until you know the total Mickey Metric.

The basic unit of length is the meter, which means "to measure". From the word meter comes our word "metric" for the whole system. How big is a meter? It's about the distance from your nose to your finger tips, about the length of a tall man's stride. But a meter is a precise amount. It is one-ten millionth of the distance from the equator to the North Pole.

You won't always want to work with a big unit, so the meter is divided into smaller units. One division is a decimeter, or 1/10th meter. It is about the width of a letter-size envelope or about as wide as a man's hand.

A smaller unit is a centimeter, or 1/100th of a meter. It is a little more than the width of a pencil or a paper clip, a little less than the width of your little finger.

Very fine measurements use the millimeter, or 1/1000th of a meter. It is about the thickness of a paper clip or the lead of a well-sharpened pencil.

How do you remember these names? Start out by association with something you know, like money. Think of the meter as a dollar. Then a decimeter is 1/10th of a meter just as a dime is 1/10th of a dollar. You can even see the word "dime" in decimeter -- DecIMEter.

A cent is 1/100th of a dollar and a centimeter is 1/100th of a meter. What could be more simple than that?

We don't deal very much with a mill, 1/1000th of a dollar, except when figuring taxes. A 1-mill rate is 1/1000th of a dollar taxed on every dollar value. A 1/1000th of a dollar is a mill;1/1000th of a meter is a millimeter.

We also need to go up the scale for measurements that are too big to measure with a meter stick. A dekameter is the word for 10 meters. It's about the width of a residential street or a two-lane country road. Dekameter sounds a little bit like the word "decade". A decade is 10 years; a dekameter is 10 meters.

Another long measure of length is 100 meters or a hectometer. This is a little longer than the length of a football field or the distance to the outfield fence in a major league baseball diamond.

The commonly used long metric measuring unit is the kilometer or 1,000 meters. It's the unit you hear of most often in measuring road distances, rivers and lakes, and other geographic features. The distance from the equator to the North Pole is a convenient 10,000 kilometers, making the distance around the earth 40,000 kilometers. The prefix "kilo" comes from a Greek word meaning 1,000.

Thus we have a convenient scale of measure, with each unit ten times as big as you go up the scale -- milli-, centi-, deci-, meter, deka-, hecto-, and kilo-. Or you can say that each unit is one-tenth as big as you go down the scale from the biggest unit -- kilo-, hecto-, deka-, meter, deci-, centi-, and milli-.

Look at the chart below to learn the common prefixes and abbreviations of the measurements of metric length.

So you have met a new friend, Mickey Metric, and you'll recognize him next time you see him. You now know one dimension of his total personality -- length. Next time you see him, you'll learn about another side of him, called volume. Later on, in a third meeting, you'll get the last dimension called mass or weight.

SUMMARY CHART ON METRIC PREFIXES AND LENGTH UNITS

Prefix Name	Prefix Symbol	Definition	Name of Length Unit	Symbol for Length Unit
kilo	k	1,000	kilometer	km
hecto	h	100	hectometer	hm
deka	da	10	dekameter	dam
--	--	1	meter	m
deci	d	.1	decimeter	dm
centi	c	.01	centimeter	cm
milli	m	.001	millimeter	mm

THE FRIENDLY CLOTH MERCHANT*

Long ago there lived a cloth trader named Obed in a faraway land. Obed was a very tall man with long arms that stretched like wings when he held up cloth for his customers to see. He was a friendly man, but not considered very wise by other men in the market.

Business was very good, and customers came from a great distance to buy cloth from Obed. One day a famous tentmaker came to buy cloth.

"How much do you want?" Obed asked him.

"About a hundred arm's length," the tentmaker replied.

"That's a great amount," Obed said, "but I can sell it to you and then buy more."

He stretched his great arms and folded the cloth back and forth 100 times and draped it over the tentmaker's donkey for his trip back home.

"You have bought almost all my cloth," Obed told the tentmaker, "but with your money I can go and buy more."

Next day Obed had to go to the next village to buy more cloth from the man who always sold it to him. Ali was a very little man, but he was also friendly and much wiser than Obed.

"A customer just bought all my cloth," Obed said. "I need to replace it so I can sell again tomorrow."

"How much did your customer buy?" Ali asked.

"One hundred arms lengths," said Obed.

"Ah, that is a lot of cloth, but I can sell it to you," he said. And he stretched his short arms out and measured the cloth until he had 100 lengths.

Obed paid Ali, loaded the cloth on his donkey, and trudged down the road back to his shop.

Next day business was good again. Obed measured 10 arms lengths for his first buyer, then 5, then 20. By the end of the day he had stretched out the cloth in his great arms many times and the cloth was all sold.

He returned to Ali in the evening and said, "I have sold all the cloth and I must replace it again. I will take 100 lengths more." Ali stretched out his tiny arms and measured 100 lengths again. Obed paid him, went back to the shop, and was ready to sell the next day.

After many days like this, Obed counted his money and found that he did not have enough to buy as many lengths of cloth as he needed. So he bought less and again the cloth sold out rapidly. Each time he returned to buy more cloth his money bought less and he sold out faster. One day Obed realized that although he had many customers, a brisk trade, and a good supplier of cloth, he was getting poor instead of rich. Finally he had to close his shop.

Here is the lesson this story teaches: No matter how much trade you have or how friendly you are to your customers, a poor measuring standard can put you out of business.

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*A fable about measurement

PREFIX CONCENTRATION

Objective: To match prefix words and number values in the metric system.

Directions: (3-4 players)

1. Cards are shuffled and placed face-down in four rows, 4 cards per row.
2. The player to the left of the dealer selects two cards and turns them up in place.
3. If the cards show a prefix and its numerical equivalent, it is a match. The player picks up the two cards and sets them in front of him/her. His/her turn resumes by picking two more cards. A player's turn continues until two cards which do not match are turned up. If the cards do not match, they are turned face-down in their places and the turn is over.
4. Play proceeds, moving clockwise around the group.
5. The game ends when all cards are used up. The player who has the most cards is the winner.

Teacher Directions:

1. Make the 16 cards, 3 x 2 inches or larger as shown in the answer key below.
2. Make a directions card and answer key and put them in an envelope with the playing cards. File appropriately.

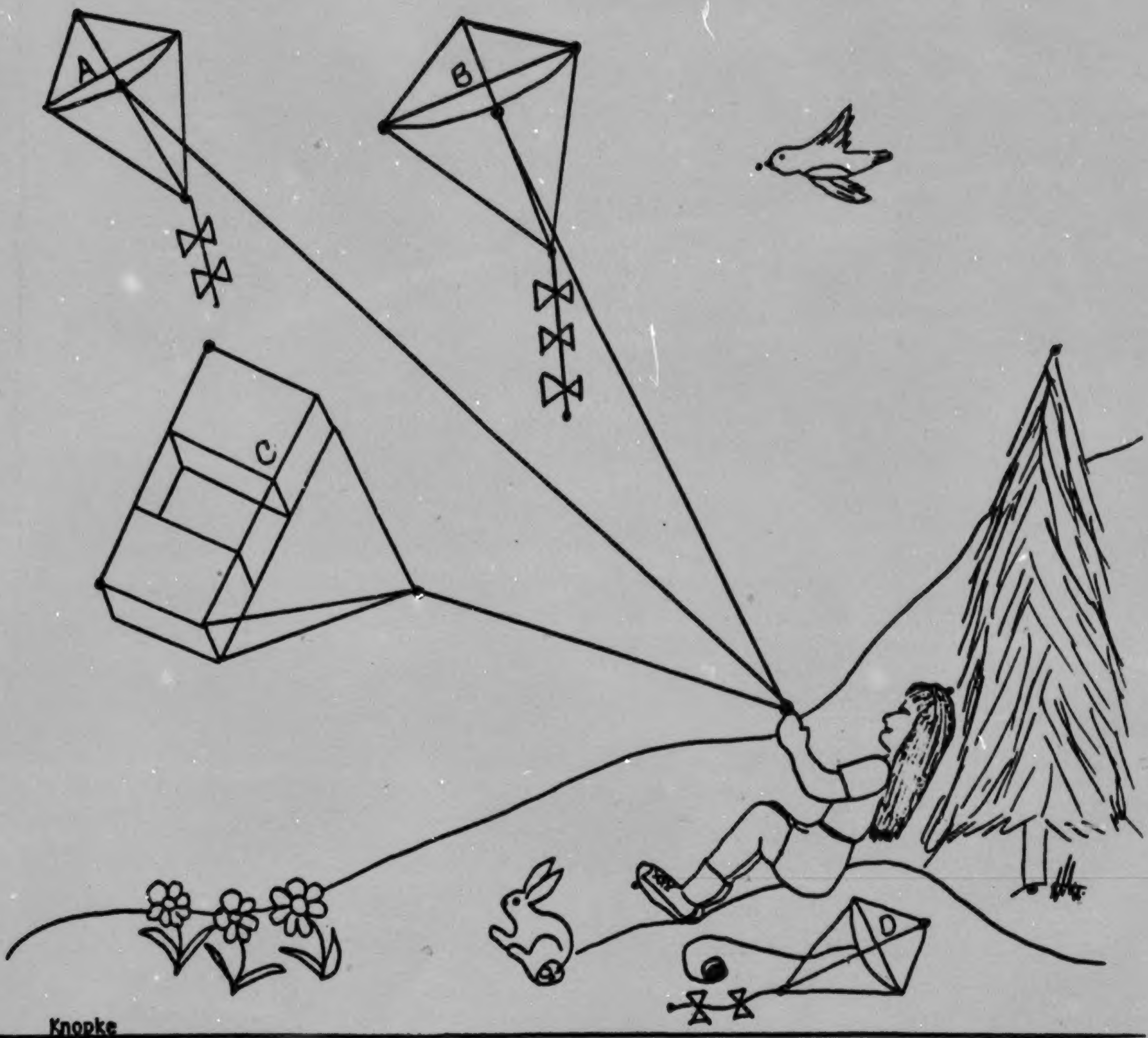
ANSWER KEY

PREFIX CONCENTRATION CARDS

milli	.001
.01	centi
hecto	100
country where metric system started	France

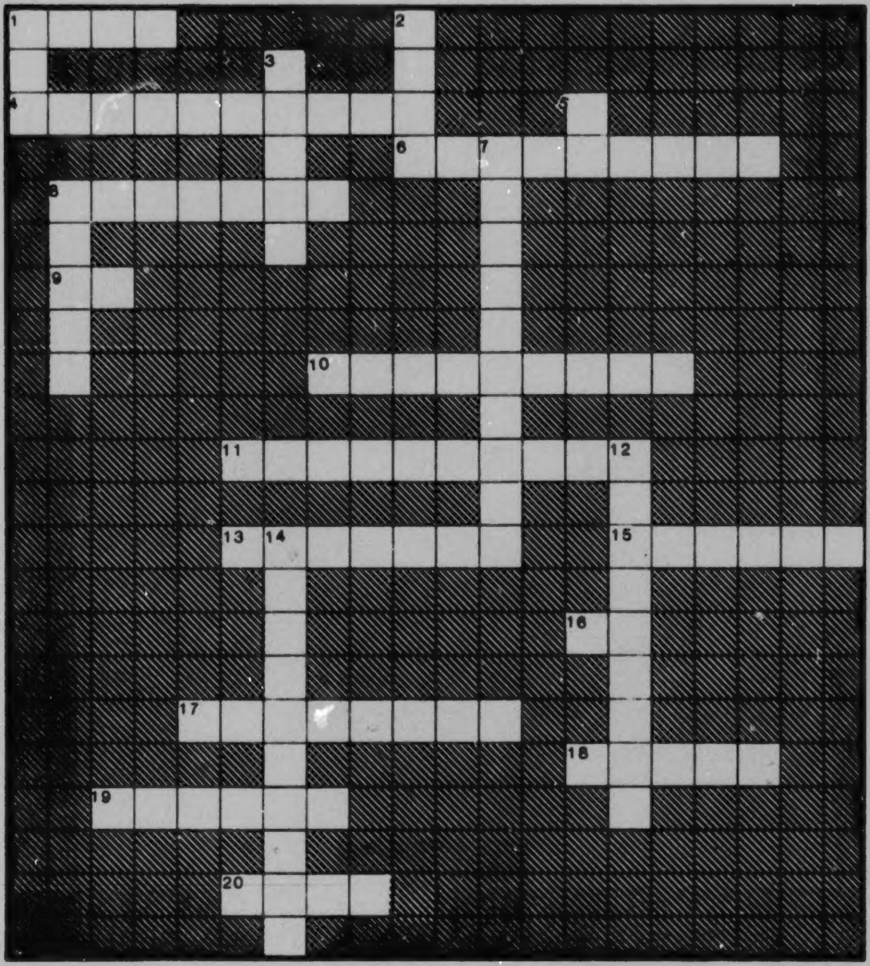
1	unit
1,000	kilo
.1	deci
10	deka

HOW LONG ARE THE KITE TAILS?



1. How long is Kite A? ________cm
2. How wide is Kite B? ________mm
3. How long is the string on Kite A? ________cm
4. How long is Kite C? ________mm
5. How long is the string on Kite C? ________cm
6. How long is Kite D? ________cm
7. How long is the tail on Kite D? ________mm
8. How long is the bird? ________mm
9. How tall is the tree? ________dm
10. How long is the girl from head to toe? ________cm

METRIC LENGTH CROSSWORD PUZZLE



ACROSS

1. prefix meaning ten
4. .001 meter
6. .1 meter
8. A meter is one ____ centimeters.
9. abbreviation for centimeter
10. 10 meters
11. A meter is measured by a ____ ____.
13. A yard is ____ than a meter.
15. A meter is a unit of ____.
16. abbreviation for kilometer
17. A meter is one ____ millimeters.
18. A prefix meaning hundredth.
19. A meter is ____ than a yard.
20. prefix meaning tenth

DOWN

1. abbreviation for dekameter
2. English unit to measure cloth
3. standard metric unit of length
5. abbreviation for millimeter
7. 10 millimeters
8. prefix meaning hundred
12. 1000 meters
14. 100 meters

MIX-A-METER

Game

Module 2

Objective: To combine various length units to make one meter.

Directions: (2-4 players)

1. Deal five cards to each player. Place the rest in a pile on the table, face-down.
2. The player to the right of the dealer takes a card from the pile and tries to "make a meter" by combining only two of the six cards he/she is holding. Try to combine only like units, such as 200 mm and 800 mm; or 90 cm and 10 cm. A wild card can take any value, or omit wild cards when combining like units if desired.
3. A discard must be made after each draw. The next player has the option of picking up the discard or taking the top card on the pile. Play continues until one player is out of cards. If the pile is exhausted before a player is out, shuffle the discards and use them as a new pile.

Variations:

1. Combine two different units such as 3 cm (equals 30 cm) and 70 cm to equal one meter.
2. Use more than two cards to make the meter. When a meter is made, it is placed on the table and counts one point.

Teacher Directions:

1. Make the 32 cards 3 x 2" or larger indicated below.
2. Make a directions card and an answer card for like units if desired, and put them in an envelope with the playing cards. File appropriately.

MIX-A-METER - CARD DATA

1 dm
2 dm
3 dm
4 dm
5 dm

9 dm
8 dm
7 dm
6 dm

10 cm
20 cm
30 cm
40 cm
50 cm

90 cm
80 cm
70 cm
60 cm

100 mm
200 mm
300 mm
400 mm
500 mm

900 mm
800 mm
700 mm
600 mm
5 "Mix-A-Meter" wild cards

Notes:

1. A wild card may be substituted for any card.
2. When three cards make a meter, have the group check its accuracy when the meter is placed on the table.

From Teacher, February 1974: "Mix-A-Meter" Hazel B. Williams, Detroit.

LENGTH LEARNING ACTIVITY #1

EQUIPMENT NEEDED: Centimeter measuring sticks or tapes, paper clips, crayons, pencils, books, chalkboard erasers

Look at each item listed below. Estimate its length in the units indicated. Record your estimate. Then measure the item and record its actual length.

	Estimate	Measurement
1. paper clip (millimeters - length)	________mm	________mm
(millimeters - width)	________mm	________mm
2. crayon (millimeters - length)	________mm	________mm
3. pencil (millimeters - length)	________mm	________mm
4. book (centimeters - length)	________cm	________cm
(centimeters - width)	________cm	________cm
5. chalkboard eraser (centimeters - length)	________cm	________cm
(centimeters - width)	________cm	________cm
6. your hand from the top of the middle finger to your wrist (centimeters)	________cm	________cm

7. Choose three other objects. Estimate their length or width. Record the estimate and measurements.

Object Name		
______________________________	__________	__________
______________________________	__________	__________
______________________________	__________	__________

LENGTH LEARNING ACTIVITY #2

EQUIPMENT NEEDED: metric tape measures, cm sticks, meter sticks, trundle wheel

Look at each object listed below. Estimate its length in the units indicated. Then measure the object and record the measurement.

	Estimate	Measurement
1. length of desk or table	____________ dm	____________ dm
2. length of chalkboard or bulletin board	____________ dm	____________ dm
3. height of wastebasket	____________ dm	____________ dm
4. your height	____________ m	____________ m
5. height of a door	____________ m	____________ m
6. length of a wall in the room	____________ m	____________ m

7. Find out how long a kilometer is. Make a route in the building or on the playground. Write instructions on the path to take. Describe the procedures you use below. Include a diagram of your path. Use a trundle wheel if one is available.

METRIC LENGTH - PRETEST

Section 1 Directions: Write the letter of the correct response in the blank to the left of each statement.

_____1. The height of a door is about:

a. 5 meters
b. 4 meters
c. 10 meters
d. 1 meter
e. 2 meters

_____2. With an outstretched arm and hand, the distance from the tip of the nose to the tip of the index finger is about one:

a. hectometer
b. kilometer
c. centimeter
d. meter
e. dekameter

_____3. 10 millimeters is equal to:

a. 1 micrometer
b. 10 decimeters
c. 1 dekameters
d. 1 centimeter
e. 10 meters

_____4. Which metric unit of length did John use to measure the science table.

a. gram
b. meter
c. foot
d. cubit
e. Fahrenheit

_____5. To find the length of a table tennis paddle, which of the following units would be used?

a. milligram
b. deciliter
c. centimeter
d. decibel
e. hectogram

_____6. 4000 meters is equal to

a. 40 meters
b. 4 kilometers
c. 4 millimeters
d. 4 centimeters
e. 400 millimeters

_____7. Ten meters equals 1

a. kilometer
b. centimeter
c. decimeter
d. dekameter
e. hectometer

Section 2 Directions: Place the answer on the line in front of each item.

8. Write symbols for the following:

a. ______ centimeter
b. ______ millimeter
c. ______ hectometer
d. ______ kilometer
e. ______ decimeter

9. Give the number (whole or fractions) for the prefixes listed below:

a. ______ kilo
b. ______ hecto
c. ______ deka
d. ______ deci
e. ______ centi
f. ______ milli

10. Indicate the relationship between the following measures in the metric system by writing in the words greater than or less than in the blank to the left of each statement.

____________________ a. 100 milliliters is --- 100 centiliters

____________________ b. 50 kilometers is --- 50 hectometers

____________________ c. 1,000 kilograms is --- 1,000 grams

____________________ d. 10 centiliters is --- 10 liters

____________________ e. 87 milligrams is --- 87 centigrams

11. Using the given list of metric units, identify which unit could best be used to measure each of these objects.

Given: millimeter, centimeter, meter, hectometer, kilometer

____________________ a. length of a sheet of paper

____________________ b. length of a football field

____________________ c. distance from New York to Buffalo

____________________ d. length of an insect

____________________ e. height of a telephone pole

12. Using a metric ruler, draw a line segment within the parentheses that is the length given. Label each line and make the end points clear.

(   ) a. 5 centimeters long

(   ) b. 7 millimeters long

METRIC LENGTH UNIT - POSTTEST

Section 1 Directions: Write the letter of the correct response in the blank to the left of each statement.

_____1. Which of the following are closest to one centimeter in length?

a. length of your thumb
b. length of a ballpoint pen
c. standard sized paper staple
d. wire paper clips
e. blackboard eraser

_____2. What part of a kilometer is equal to a hectometer?

a. 1/100th
b. 1/10th
c. 1/1000th
d. 1/10000th
e. 1/2

_____3. Charlie Brown measured his tree house and the meter-stick read 10 meters. This is the same as a:

a. kilometer
b. centimeter
c. decimeter
d. dekameter
e. hectometer

_____4. The metric unit, milliliter, could be used to measure the

a. amount of milk in a glass
b. weight of a feather
c. width of your eye's pupil
d. volume of a fountain pen
e. heaviness of a plant's leaf

_____5. Ten dekameters are equivalent to

a. 10 meters
b. 100 centimeters
c. 1000 meters
d. 10 milliliters
e. 100 meters

_____6. Jim Ryan ran the 100 meter dash in 35 seconds. How many hectometers did he run?

a. 1000
b. 100
c. 10
d. 1
e. .1

_____7. Which of these symbols means decimeter?

a. dl
b. dam
c. dcl
d. dm
e. dcg

_____8. Which of these prefixes means 1/100th?

a. hecto
b. deci
c. kilo
d. centi
e. deka

_____9. The meter is the basic unit of metric

a. volume
b. length
c. weight
d. temperature
e. time

_____10. 1 dekameter is equivalent to

a. 10 meters
b. 100 centimeters
c. 1000 meters
d. 10 millimeters
e. 100 meters

Section 2 Directions: Write the answer in the answer block to the right of each problem.

11. Write in either centimeter or kilometer as the appropriate measure.

   a. Paper clips are about 3 ____ long. 11a. 3__________________

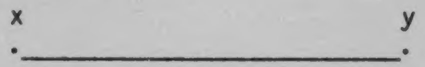
   b. City blocks are about 1/5 ____ long. 11b. 1/5________________

   c. New pencils are about 18 ____ long. 11c. 18_________________

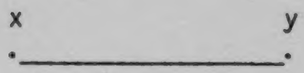
   d. Madison is about 240 ____ from Chicago. 11d. 240________________

12. Estimate the distance in meters from the school building to the street indicated by your teacher. 12.________________meters

13. Measure these line segments to the nearest centimeter.

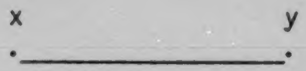
a.


13a. ____________________

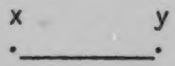
b.


13b. ____________________

14. Measure these line segments to the nearest millimeter.

a.


14a. ____________________

b.


14b. ____________________

15. How many kilometers in 5,000 meters? 15. ____________________km

METRIC VOLUME

Module 3

Objectives

The participant will be able to:

1. identify and describe the basic unit of volume.
2. apply the six basic prefixes to the volume unit.
3. accurately measure materials holding a variety of volumes using the six basic prefixes and basic volume unit.
4. identify instances where he/she would use the liter and each of the six other units of metric volume in daily life.

Suggested Activities to Meet Objectives

1. Read narrative "Metric Volume."
2. Study the "Summary Chart on Metric Volume Units."
3. Play the game, LITER LOTTO.
4. Work the crossword puzzle, METRIC VOLUME.
5. Complete learning activities 1, 2 and 3 on metric volume.
6. Review additional games and activities on metric volume in Appendix B.

Illustration of Mastery

1. Participation in game, LITER LOTTO
2. Agreement of satisfactory between instructor and participant on completion of:
    a. volume learning activity #1.
    b. volume learning activity #2
    c. volume learning activity #3
    d. METRIC VOLUME crossword puzzle
3. Completion of "Metric Volume Unit Posttest" with 80 percent accuracy.

METRIC VOLUME

You've met Mickey Metric. In your first meeting you got a look at one dimension of him called length. Now you'll get to know him better as you learn something else about him called volume, or capacity.

His volume is measured in a basic unit derived from length, called the liter. The liter measures 10 centimeters long by 10 centimeters high by 10 centimeters deep or 1000 cubic centimeters. It is a little larger than a quart.

We can divide a liter into tenths and call each part a deciliter; into hundredths, a centiliter; and into thousandths, a milliliter. The most commonly used volume terms are liter and milliliter. To get an idea of size of a milliliter, remember that there are 5 milliliters in a teaspoon. The deciliter and centiliter are used for cooking and meal service.

When we go larger than a liter, we call 10 liters a dekaliter; 100 liters a hectoliter, and 1000 liters a kiloliter. Traditionally, the liter is used to measure the volume of liquids. For the volume of solids such as cement and stone, we use the term cubic meter, rather than kiloliter. A cubic meter is one million cubic centimeters (100 cm x 100 cm x 100 cm) or one million milliliters (1000 ml x 1000) or 1000 liters. A cubic meter is a little larger than a cubic yard. The volume of gases is also traditionally measured in cubic meter or related units.

Remember to use the prefixes for volume in the same way as you used them for length. Names, symbols and values for these units appear below.

SUMMARY CHART ON METRIC VOLUME UNITS

NAME OF VOLUME UNIT	SYMBOL FOR VOLUME UNIT	DEFINITION OF VOLUME UNIT
kiloliter	kl	1000 liters
hectoliter	hl	100 liters
dekaliter	dal	10 liters
liter	l	1 liter
deciliter	dl	.1 liter
centiliter	cl	.01 liter
milliliter	ml	.001 liter

LITER LOTTO

Volume
Game

Module 3

Objective: To match volume terms and symbols.

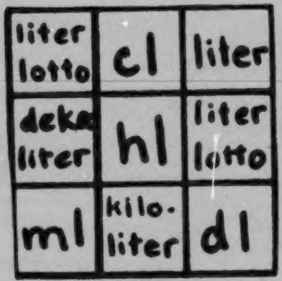
Directions: (2 to 4 players)

1. Each player takes a large LITER LOTTO card.
2. The deck of playing cards is shuffled and placed face-down in the center of the table.
3. The object of the game is to cover each space on the LITER LOTTO card with an equivalent card from the deck. LITER LOTTO spaces are free and do not need to be covered.
4. The first player picks the top playing card from the deck and tries to match it with a word or symbol on his/her LITER LOTTO card. Words are matched with symbols and symbols are matched with the corresponding words. Pairing words to words or symbols to symbols does NOT make a match.
5. If the player can make a match, the playing card is placed on the corresponding space on the LITER LOTTO card; if not, the card is placed face-up on the discard pile. This completes a turn.
6. Play rotates clockwise around the group. The next player may pick up the top card from either the discard pile or the deck.
7. If the deck pile is used up, the discard pile is shuffled, placed face-down on the table and becomes the deck.
8. The winner is the first one to cover all spaces except the free LITER LOTTO spaces.

Teacher Directions/Materials

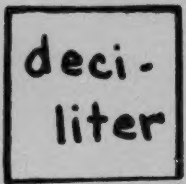
1. Make 4 LITER LOTTO cards 9 x 9 inches with 9 spaces on each card. Two spaces are marked LITER LOTTO; other spaces are marked with a word or symbol from the list below (See illustration):

kiloliter - kl
hectoliter - hl
dekaliter - dal
liter - l
deciliter - dl
centiliter - cl
milliliter - ml



liter lotto	cl	liter
deka liter	hl	liter lotto
ml	kilo-liter	dl

LITER LOTTO card

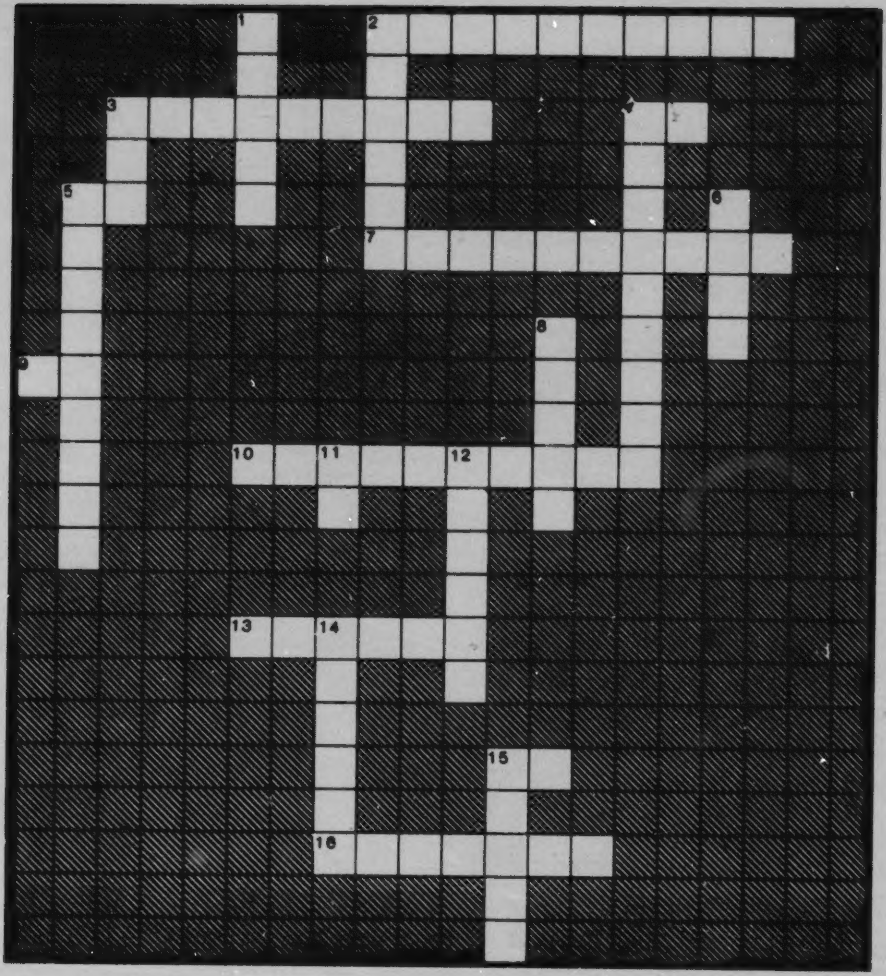


PLAYING card

2. Make a deck of 28 LITER LOTTO playing cards, each 3 x 3 inches, to fit the spaces on the large card. Make 2 cards for each of the 7 words and symbols presented in number 1 above. See sample playing card on the right.
3. Put large LITER LOTTO cards and playing cards in an envelope and file appropriately.

METRIC VOLUME CROSSWORD PUZZLE

Module 3



ACROSS

2. .001 liters.
3. 10 liters.
4. Abbreviation for deciliter.
5. Abbreviation for kiloliter.
7. .01 liters.
9. Abbreviation for hectoliter.
10. 100 liters.
13. A liter is a metric unit of _______.
15. Abbreviation for milliliter.
16. A quart is ______ than a liter.

DOWN

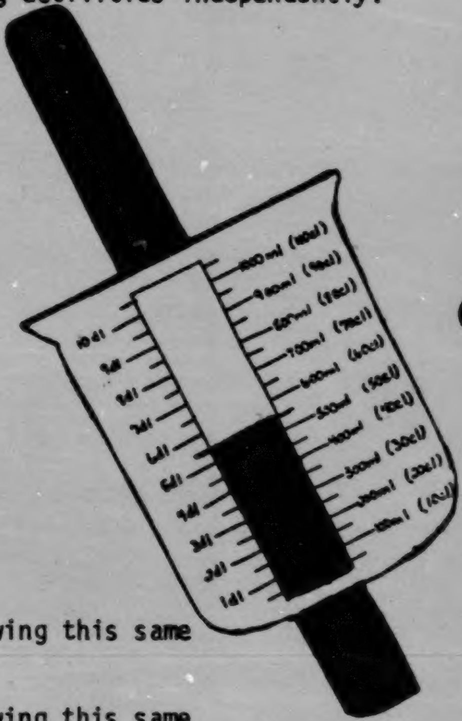
1. English unit to measure milk or oil for a car.
2. System of standard measure using meter, liter and and gram.
3. Abbreviation for dekaliter.
4. .1 liters.
5. 1000 liters.
6. Prefix meaning tenth.
8. Prefix meaning hundredth.
11. Abbreviation for centiliter.
12. A liter is ______ than a quart.
14. Basic metric unit of volume (plural).
15. Prefix meaning thousandth.

VOLUME LEARNING ACTIVITY #1

EQUIPMENT NEEDED: beakers - made out of cardboard with slots cut above and below the volume marking; a strip of paper, half red and half white, is woven into the open center (see illustration, p. 44). The beakers work on the same principle as paper thermometers used with primary children.

The students work in small groups (4-5). Each group can work with one beaker or, if possible, each person can have a beaker.

The instructor can present measurements in liters and have the students pull the strip so that the red part marks the designated measurement. Or the students may be asked to work through the following activities independently:


10dl
9dl
8dl
7dl
6dl
5dl
4dl
3dl
2dl
1dl
1000ml (100cl)
900ml (90cl)
800ml (80cl)
700ml (70cl)
600ml (60cl)
500ml (50cl)
400ml (40cl)
300ml (30cl)
200ml (20cl)
100ml (10cl)

1. How big is your beaker?
    a. How many deciliters is that?
    b. How many centiliters is that?
    c. How many milliliters?
2. Make your beaker show 500 ml.
3. Make your beaker show 5 dl.
4. Make your beaker show 20 cl.
5. Make your beaker show 2 dl.
6. Make your beaker show 100 cl.
7. Make your beaker show 7 dl.
8. Show 5 dl and write two other ways of showing this same level of measure.
9. Show 8 dl and write two other ways of showing this same level of measure.
10. Show 3 dl and write two other ways of showing this same level of measure.

VOLUME LEARNING ACTIVITY #2

EQUIPMENT NEEDED: bucket containing more than one liter of colored water, quart containers, liter containers (with ml markings), 5 paper cups, extra container (at least 500 ml), graduated cylinders.

1. Fill the quart container with colored water. Pour the water from the quart container into the liter.

   Which is more, the quart or the liter? 1.________________

2. Add enough water to fill the liter. Pour half of the liter of water into another container.

   How many milliliters are left? 2a.________________

   How many centiliters are left? b.________________

   How much is that in deciliters? c.________________

3. Set 5 paper cups on the table. Try to divide 500 ml of water equally into the five cups. Find out how much water is in each cup by pouring it into a graduated cylinder.

   How many milliliters is it? 3a.________________

   How many centiliters is it? b.________________

   How many deciliters is it? c.________________

Empty the water back into the original container. Be sure the station is neat when you have finished.

VOLUME LEARNING ACTIVITY #3

EQUIPMENT NEEDED: Water, liter measure, drinking glass, baby food jar, coffee cup, assorted containers.

1. Look at the liter measure. How many milliters does it hold? 1. ____________________

2. a. Estimate the capacity of the drinking glass. Record. 2a. ____________________

   b. Measure the amount of water the drinking glass actually holds. Record. 2b. ____________________

3. a. Estimate the capacity of the baby food jar. Record. 3a. ____________________

   b. Measure the water in the baby food jar. Record. 3b. ____________________

4. a. Estimate the capacity of the coffee cup. Record. 4a. ____________________

   b. Measure the water in the coffee cup. Record. 4b. ____________________

5. Choose other containers. Estimate their volume or capacity, then measure. Record estimates and measurements.

Container Name	Estimate	Measurement

METRIC VOLUME - POSTTEST

1. What is the basic unit of volume in the metric system? 1. ____________

2. A quart is (larger/smaller) than a liter. 2. ____________

3. 1 liter = ____________ milliliters 3. ____________

4. 1 liter = 100 ____________ 4. ____________

5. 10 liters = 1 ____________ 5. ____________

6. 100 ____________ = 1 hectoliter 6. ____________

7. ____________ liters = 1 kiloliter 7. ____________

8. 1 liter = ____________ deciliters 8. ____________

Put the correct letter from the column on the right in front of the word on the left.

____________ 9. kiloliter
____________ 10. hectoliter
____________ 11. dekaliter
____________ 12. liter
____________ 13. deciliter
____________ 14. centiliter
____________ 15. milliliter

a. hl
b. mg
c. ml
d. cg
e. kl
f. kg
g. cl
h. dl
i. l
j. dal

METRIC MASS

Objectives

The participant will be able to:

1. identify and describe the basic unit of mass.
2. apply the six basic prefixes to the basic mass unit.
3. accurately measure materials of different masses using the six basic prefixes and the basic mass unit.
4. identify instances where he/she would use the gram and each of the six units of mass in daily life.
5. identify and describe the kilogram and explain its common use in daily life.

Suggested Activities to Meet Objectives

1. Read narrative "Metric Mass."
2. Study the "Summary Chart on Metric Mass Units."
3. Play the game, GUESS-A-GRAM.
4. Work the crossword puzzle, METRIC MASS.
5. Complete learning activities #1 and #2.
6. Play the game, METRIC MASS DOMINOS.
7. Review additional games and activities on metric mass in Appendix B.

Illustration of Mastery

The participant will illustrate mastery by:

1. participation in games, GUESS-A-GRAM and METRIC MASS DOMINOS.
2. agreement of "satisfactory" between participant and instructor on completion of:
    a. mass learning activity #1.
    b. mass learning activity #2.
    c. METRIC MASS crossword puzzle.
3. completion of posttest on METRIC MASS with 80 percent accuracy.

METRIC MASS

Now you know about Mickey Metric and the metric system in terms of length and volume. There is one more measurement which will give you the complete dimensions of the system. That measurement is mass.*

The basic unit of metric mass is the kilogram, which on earth is about twice as heavy as a pound. The kilogram equals 1000 grams. The gram is a very small unit that is useful in scientific work, but the kilogram (1000 grams) is the most convenient unit for everyday use.

Units of mass are measured in smaller or larger amounts using the six prefixes you have now become acquainted with. A tenth of a gram is a decigram; 1/100th of a gram is a centigram; and 1/1000th of a gram is a milligram. Going up the scale from the basic mass unit, the gram, you have 10 grams equal to a dekagram; 100 grams to a hectogram; and 1000 grams to a kilogram. The most common mass units you will use are the milligram, gram and kilogram. Very large amounts of materials like coal and cement are measured in a 1000 kilogram unit which is called a metric ton: it is slightly heavier than our familiar ton. These units along with their symbols and values appear below.

SUMMARY CHART OF METRIC MASS UNITS

NAME OF MASS UNIT	SYMBOL FOR MASS UNIT	DEFINITION OF MASS UNIT
kilogram	kg	1000 grams
hectogram	hg	100 grams
dekagram	dag	10 grams
gram	g	1 gram
decigram	dg	.1 grams
centigram	cg	.01 grams
milligram	mg	.001 grams

---

*Mass is defined as a quantity of matter. Weight is defined as a force. The force is the earth's gravitational pull or attraction for a given mass. Usually we mean mass when we use the term weight. On the earth, these two units are approximately identical, but out in space weight changes, while mass remains constant.

GUESS-A-GRAM

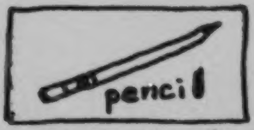
Objective: The student will be able to estimate and measure common objects in mass units.

Directions: (2-4 players)

1. The GUESS-A-GRAM cards are shuffled and placed face-down in the center of the game board. Each player chooses a colored token or marker and places it at the beginning of the road to HOME.
2. The first player picks a GUESS-A-GRAM card and estimates the mass of the object on the card. He/She writes an estimate on his/her paper or expresses it verbally and passes the object to the person on the left. Play moves clockwise around the group with each player, in turn, estimating the mass of the object. Then the object is weighed on the scale and the person whose estimate came closest to the actual mass moves ahead one space. If 2 guesses are equally close, both players move ahead 1 space.
3. The next player then picks a card and is first to estimate the mass of the object on the card. The mass of the object is then estimated by each of the other players.
4. When a card says CHOICE the player can choose any object in the room for the group to estimate its mass.
5. The first player to reach the HOME circle is the winner.

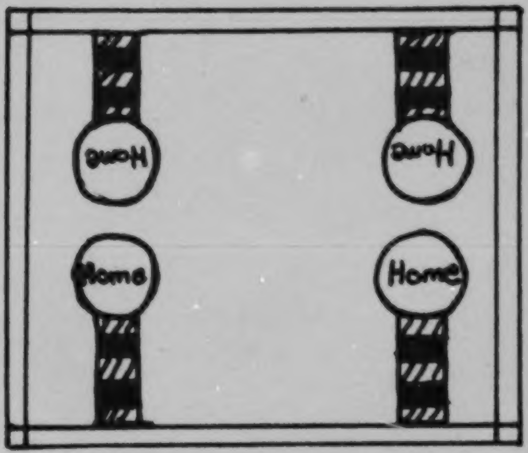
Teacher Directions/Materials

1. Make 10 - 20 GUESS-A-GRAM cards, each illustrating a common object whose weight is to be estimated such as: pencil, ruler, tape dispenser, crayon, scissors, stapler, notebook and 2 GUESS-A-GRAM cards marked CHOICE.



Sample Playing Card

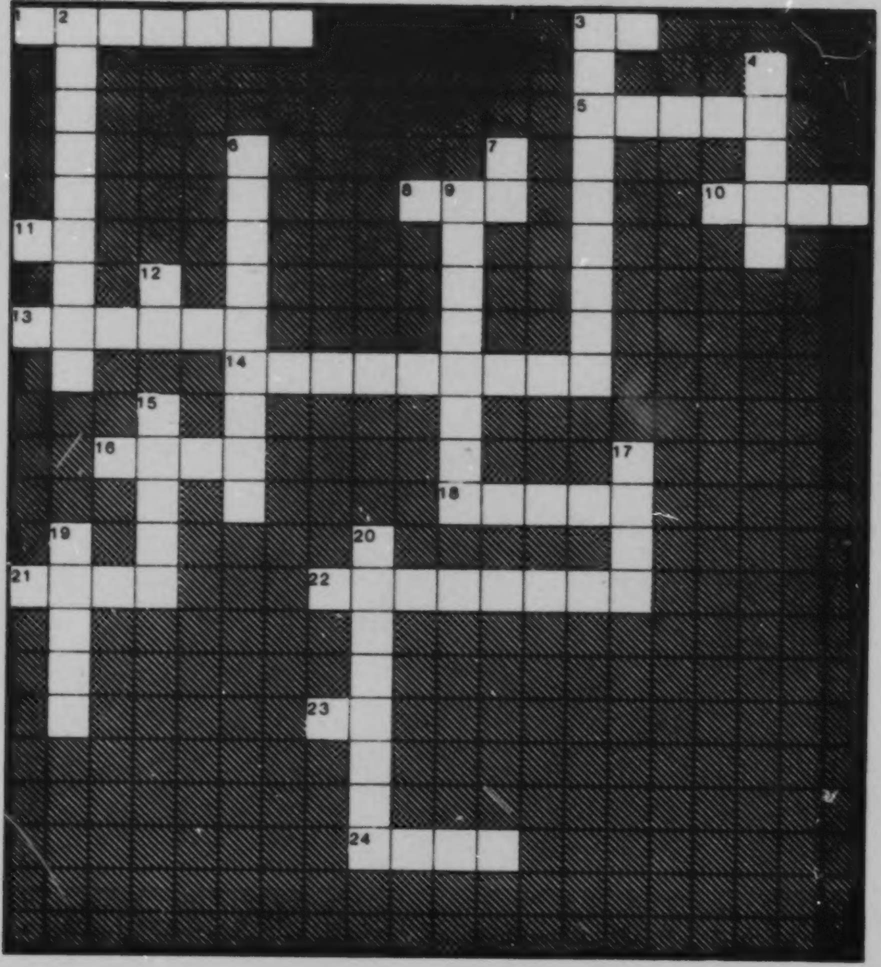
2. Collect 10 - 20 objects which match the illustrations on the cards in #1 above.
3. Provide a balance scale (accurate to at least 1 gram) and metric weights appropriate to the scale.
4. Provide one GUESS-A-GRAM board (See illustration) and 4 tokens.
5. Provide a sheet of paper and a pencil for each player.



Sample GUESS-A-GRAM board

METRIC MASS CROSSWORD PUZZLE

Module 4



ACROSS

1. A gram is _____ than a pound.
3. Abbreviation for hectogram.
5. Prefix meaning hundreth.
8. Abbreviation for dekagram.
10. Prefix meaning ten.
11. Abbreviation for kilogram.
13. A pound is _____ than a gram.
14. .01 grams.
16. Prefix meaning tenth.
18. Standard metric unit of length.
21. Prefix meaning thousand.
22. 10 grams.
23. Abbreviation for centigram.
24. A gram is a unit of ______.

DOWN

2. .001 grams.
3. 100 grams.
4. Standard metric unit of volume.
6. Common object with a mass of 1 gram (2 words)
7. Abbreviation for milligram.
9. 1000 grams.
12. Abbreviation for decigram.
15. Prefix meaning hundred.
17. Standard metric unit of mass.
19. Prefix meaning thousandth.
20. .1 gram.

MASS LEARNING ACTIVITY #1

EQUIPMENT NEEDED: Regular paper clips, black crayon, large paper clip, pencil, ruler, roll of tape

Weigh the items and record their weights below:

1. Five small paper clips weigh ______. 1.____________________grams

2. The black crayon weighs ______. 2.____________________grams

3. The pencil weighs ______. 3.____________________grams

4. The large paper clip weighs ______. 4.____________________grams

5. The ruler weighs ______. 5.____________________grams

6. The roll of tape weighs ______. 6.____________________grams

7. Choose other objects from the room, each of which weighs about 50 grams. List the objects you found. 7.________________________

____

____

____

____

MASS LEARNING ACTIVITY #2

EQUIPMENT NEEDED: A variety of objects weighing 10 gr, 100 gr and 1,000 gr.

Find objects in the room (or in your purse or pocket) which weigh the following metric mass units. List the objects or group of objects in the column at the right.

1. I've found these objects to weigh about 10 grams:

1a.____________________
1b.____________________
1c.____________________
1d.____________________

2. I've found these objects to weigh about 100 grams:

2a.____________________
2b.____________________
2c.____________________
2d.____________________

3. I've found these objects to weigh about 1 kilogram:

3a.____________________
3b.____________________
3c.____________________
3d.____________________

4. The object in the room weighing closest to one kilogram is:

4a.____________________

5. Name four objects that weigh approximately 1000 grams.

5a.____________________
5b.____________________
5c.____________________
5d.____________________

METRIC DOMINOES

Objective: The student will be able to match mass units with their equivalent units.

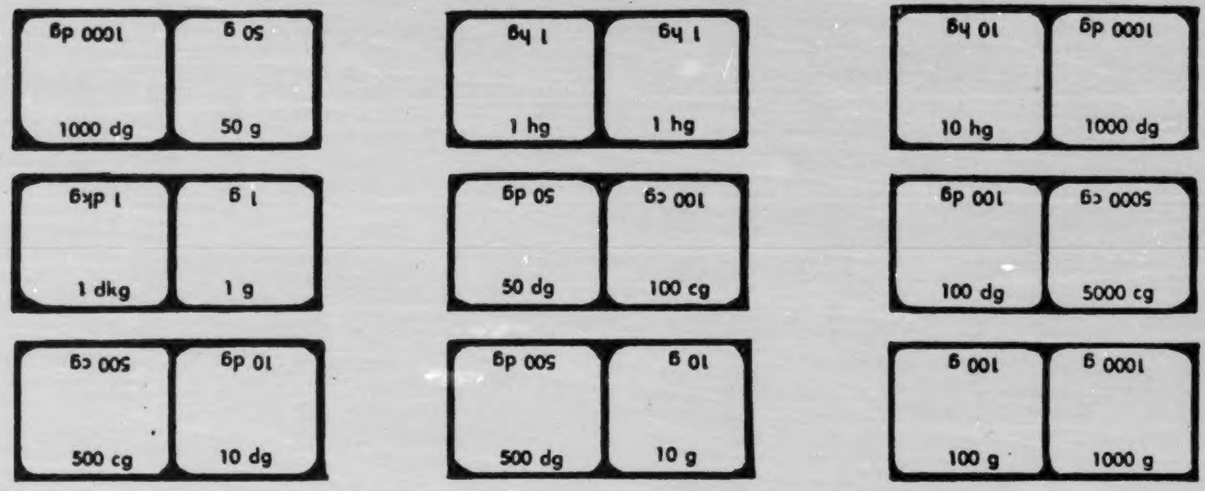
Directions: (2-4 players)

1. Dominoes cards are placed in a pile in the center, face-down. Each player picks 4 dominoes. To start, one domino is placed face-up in the center of the playing area.
2. The player attempts to match one of his/her dominoes to the one in the center so that the two mass measurements are the equivalent. Identical dominoes are not a match (e.g., 50 g cannot be matched with 50 g).
3. Play continues with each player attempting to match one of his/her dominoes with the one in the playing area. (Regular domino rules apply.)
4. If a player cannot make a match, he/she draws a domino from the middle. If he/she still cannot make a match, that ends the player's turn.
5. The first player out of dominoes is the winner.

Teacher Directions/Materials

1. Make the 28 dominoes shown below and on the next page in miniature on 1 x 2" cardboard.
2. Make a directions card using the exact copy above.
3. Store the dominoes and directions card in an envelope and file appropriately.

METRIC DOMINOES



METRIC DOMINOES cont.

1000 dg | 5 g
5000 mg | 5000 mg
1000 dg | 100 dg
5000 mg | 1 g
500 cg | 500 cg
1 kg | 1 kg

5000 cg | 500 cg
100 cg | 1 dg
50 dg | 500 dg
5 g | 1000 mg
1 g | 1 g
1 hg | 100 dkg
1 kg | 10 dkg

1 dkg | 1 kg
1000 cg | 5000 dg
10 g | 5000 mg
1000 g | 5 dkg
100 g | 10 dg
50 g | 10 dkg

METRIC MASS - POSTTEST

(Module 4)

1. What is the basic unit of mass in the metric system? 1. ____________
2. A pound is (heavier/lighter) than a gram. 2. ____________
3. 10 ____________ = 1 dekagram 3. ____________
4. 100 grams = 1 ____________ 4. ____________
5. 100 ____________ = 1 gram 5. ____________
6. 1,000 grams = 1 ____________ 6. ____________
7. 1 gram = ____________ milligrams 7. ____________
8. 1 gram = 10 ____________ 8. ____________

Put the correct letter from the column on the right in front of the word on the left.

____________ 9. centigram

____________ 10. dekagram

____________ 11. milligram

____________ 12. hectogram

____________ 13. gram

____________ 14. kilogram

____________ 15. decigram

____________ 16. metric ton

a. hg

b. 1000 g.

c. dg

d. 10 grams

e. dag

f. 1000 kg

g. cg

h. mg

i. Mg

j. g

k. 100 grams

METRIC TEMPERATURE

Module 5

Objectives

The participant will be able to:

1. identify and describe the metric temperature measuring scale, the Celsius scale.
2. accurately measure a variety of temperatures using the metric scale.
3. identify commonly occurring temperatures in Celsius degrees.

Suggested Activities to Meet Objectives

1. Study narrative on "Measuring Temperature in Metric Units."
2. Study diagram on "Celsius and Fahrenheit Temperature Scales."
3. Complete Learning Activities #1 and #2.
4. Complete "Temperature Puzzle."
5. Play game, TEMPERATURE CONCENTRATION.
6. Review games and activities on metric temperature in Appendix B.

Illustration of Mastery

1. Participation in game, TEMPERATURE CONCENTRATION.
2. Agreement of satisfactory between instructor and participant on completion of:
    a. Temperature Learning Activity #1.
    b. Temperature Learning Activity #2.
3. Completion of "Metric Temperature Posttest" with 80% accuracy.

MEASURING TEMPERATURE IN METRIC UNITS

In countries where metric measurement is used, temperature is also measured in a system that divides the scale into 100 convenient degrees. This is called Celsius temperature and originally was called centigrade. It is named after Anders Celsius who designed the scale.

The 100 degrees in the Celsius scale are measured between the freezing point and boiling point of water. Thus, we already have two "benchmarks" on the scale--at 0°C., water freezes, at 100°C., water boils. In North America, we live and perform most activity between 0° and 30°C. Our outdoor temperature extremes are about -30° to 40°C.

Let's look at some other benchmarks on the Celsius scale shown on the next page that will help you to know whether a metric temperature is hot or cold. A good one to remember is 20°C., which scientists call standard room temperature for comparing various materials that expand or shrink as temperature changes. Twenty degrees Celsius is equal to 68°F. The human body begins to feel chilled below 20°C. and is comfortable for about 10 degrees above 20°C. You can think of 20°C.-30°C. as the human "comfort zone." Another temperature benchmark is 37°C. which is normal human body temperature.

Our cold weather temperatures are based on zero degrees Fahrenheit which is -17°C. When you talk about subzero weather in Celsius degrees, you are talking about the temperatures where flowers and garden plants may be permanently killed, and people begin to suffer some discomfort.

At -20°C. people are in danger of getting frostbite on exposed body parts such as ears, face, and hands. At -30°C. temperature gets into the range of the coldest weather in the United States. At -40°C. mercury becomes a solid. This is also the same temperature as -40° on the Fahrenheit scale. Some observable benchmarks on the Celsius temperature scale are given in Figure 1. A Fahrenheit scale is also included for your information.

It is easy to convert from one scale to another by using the following formulas:

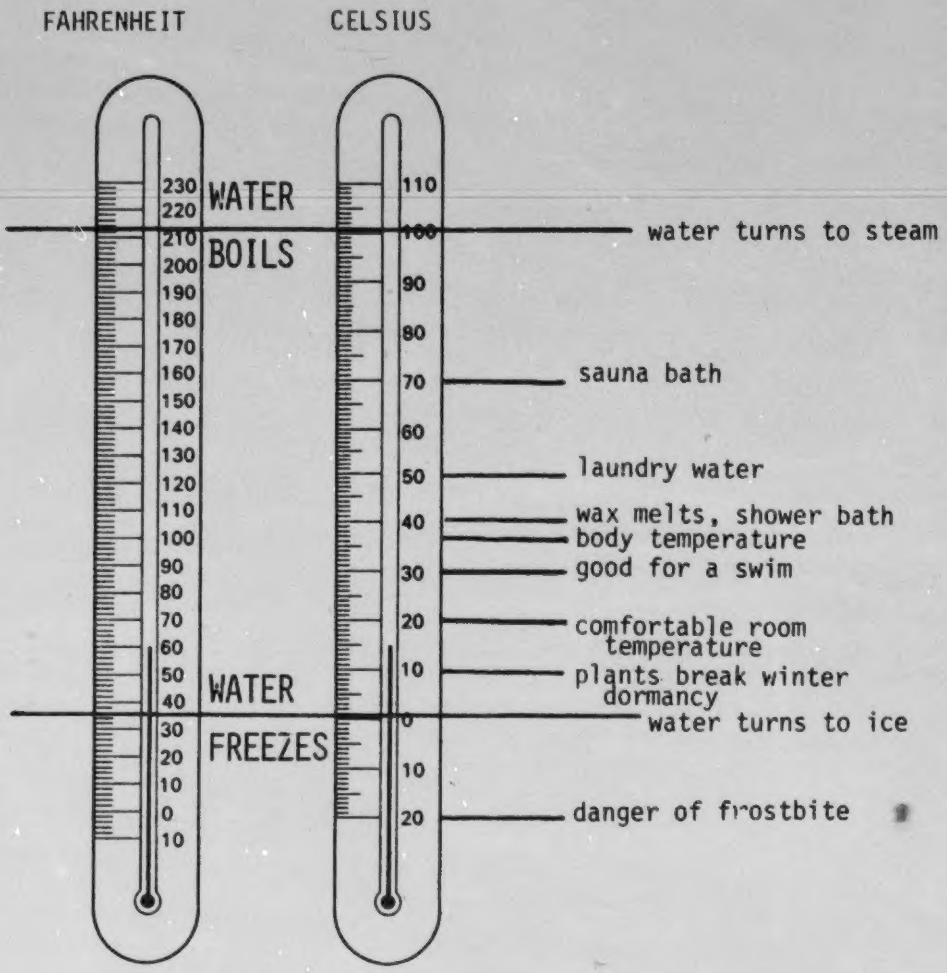
Fahrenheit to Celsius	Celsius to Fehrenheit
$C = \frac{5(F - 32)}{9}$	$F = \frac{9}{5} C + 32$

Remember to estimate your answer before you calculate so you will know whether or not your answer is reasonable.

On either scale the numbers refer to the same thing, the motion of the molecules. At 100°C. the molecules of a substance are vibrating faster than at 0°C. But even at 0°C. the molecules are vibrating. So we have to use numbers below zero to describe still slower vibrations, and thus still lower temperatures.

Colder and slower, still colder and slower--is there a temperature at which molecules nearly stop vibrating altogether? There is and it is called absolute zero. It is about 459 degrees below the zero on the Fahrenheit scale. It is 273 degrees below the zero of the Celsius scale. The scale on which absolute zero and temperatures related to it are measured is called the Kelvin Scale. Look up this temperature scale in an encyclopedia or science reference book for more information about it.

Figure 1. CELSIUS AND FAHRENHEIT SCALES


FAHRENHEIT
CELSIUS
230
220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
10
WATER BOILS
WATER FREEZES
110
100
90
80
70
60
50
40
30
20
10
0
10
20
water turns to steam
sauna bath
laundry water
wax melts, shower bath
body temperature
good for a swim
comfortable room temperature
plants break winter dormancy
water turns to ice
danger of frostbite

To learn the Celsius scale, become familiar with useful points on the scale. The human body "comfort zone" is 20-30°C. Body temperature is 37° C., and "room temperature" is 20° C.

Remember that both scales are "man made" and use the freezing point (32° F. and 0° C.) and boiling point (212° F. and 100° C.) as guide points.

TEMPERATURE LEARNING ACTIVITY #1

Fill a container with very hot water. Measure the temperature with a Celsius thermometer and record it on the chart below. Continue measuring the temperature at three (3) minute intervals until the readings stay the same.

Time	Celsius Temperature
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	

*OPTIONAL: Graph your results with the Celsius thermometer putting the time on one axis and the Celsius temperature on the other axis.

*OPTIONAL: Take the temperature readings in both Celsius and Fahrenheit degrees. Chart (on the above table) and graph the results from both scales. Compare your results.

*Adapted from Individualized Science, Lagrange Student Activity #13.

TEMPERATURE LEARNING ACTIVITY #2

Find a thermometer with both Celsius and Fahrenheit scales on it, or use separate Celsius and Fahrenheit thermometers.* Record the outside temperature for a week or longer. Make your measurements at about the same time each day and in the same location. (For example, outside the back door, outside the window, etc.) Record your findings on a chart like the one below. Be sure you leave room to write the word description of the weather.

DATE	TIME	TEMPERATURE C°	WORD DESCRIPTION OF WEATHER**	TEMPERATURE F°

*Use only Celsius temperatures if desired.

**For example, cool sunny day, needed lightweight jacket.

*Adapted from Individualized Science, Lagrange Student Activity #7

Puzzle

TEMPERATURE PUZZLE

Module 5

Solve the following problems. Write the correct answers on the blanks at the right. Notice that the letters under each blank are part of the code for solving the puzzles at the end of the problems. The first problem is completed for you.

		ANSWER KEY
1. The average summer temperature for the Great Lakes is 18° Celsius. The average temperature of the Gulf of Mexico is 29° Celsius. What is the difference in average temperature for the two bodies of water?	____ C A	11 C A
2. Find the average temperature for five lakes in Pasco County on a given day when the temperatures were 30°C, 28°C, 32°C, 29°C, and 31°C.	____ °C N	30 C N
3. A certain candy recipe calls for cooking the mixture until the temperature reaches 120°C. If Jean has the mixture at 87°C now, how many degrees must the temperature increase?	____ °C B	33 C B
4. If it took 3 hours for a 3 kilogram beef roast to increase its temperature from 1°C to 85°C, what was the average number of degrees the temperature rose per hour?	____ °C R	28 C R
5. Normal body temperature is 37°C. Normal room temperature is about 22°C. How many degrees warmer is your body than normal room temperature?	____ °C D	15 C D
6. The boiling point of water is 100°C. Alcohol boils at 78°C. How many degrees difference is there in their boiling points?	____ °C L	22 C L
7. One week in June, New York City had the following temperatures: 25°C, 27°C, 29°C, 22°C, 24°C, 28°C, and 27°C. Find the average temperature for that June week.	____ °C S	26 C S
8. One chilly winter day the temperature dropped from 5°C to -8°C. How many degrees did the temperature fall?	____ °C I	13 C I
9. While Carol was helping her mother cook dinner, she noticed the meat loaf recipe called for an oven temperature of 220°C. If the oven had already heated to 41°C, how many degrees must it still increase?	____ °C W M G	179 C W M G

Adapted from Amusements in Developing Metric Skills, p. 36-37.

Temperature Puzzle cont.

			ANSWER KEY
10.	A chocolate chip cookie recipe calls for a baking temperature of 190°C. If the oven overheated 55°C, what would its temperature be?	___ °C U C E	245 C U C E
11.	During a hot month in Dodge City the noon daily temperatures averaged 12°C above normal. What was the total number of degrees above normal for those 30 days?	___ °C T H	3 60 C T "H"
12.	One winter day when the temperature was 22°C in Hawaii, it was -22°C in Alaska. What was their temperature difference?	___ °C F	44° C F
13.	How many Celsius degrees are there between the boiling point and freezing point of water?	___ °C V	100° C V
14.	How many Celsius degrees are there between the boiling point of water and normal body temperature?	___ °C K	63° C K

Complete the puzzles below by filling in the letter which corresponds to the number under each blank. The numbers are the answers to the problems above, and the letters are those which are listed under the answer blanks. As an example, 11 is the code for A; an A has been written in each blank where the number 11 appears.

English physicist and mathematician who devised a scale of temperature:

1 13 22 22 13 $\overset{A}{11}$ 7   6 5 22 10 13 30   (William Kelvin)

Swedish astronomer who devised a temperature scale:

$\overset{A}{11}$ 30 15 5 8 26   4 5 22 26 13 2 26   (Anders Celsius)

German physicist who devised a temperature scale and introduced the use of mercury in thermometers:

9 $\overset{A}{11}$ 33 8 13 5 22   44 $\overset{A}{11}$ 60 8 5 30 60 5 13 3   (Gabriel Fahrenheit)

TEMPERATURE CONCENTRATION

Temperature
Game

Module 5

Objective: To match Celsius temperatures and common situations.

Directions: (3-4 players)

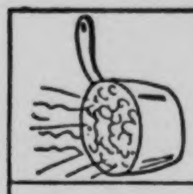
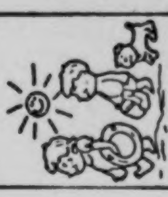
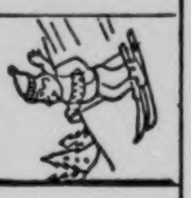
1. Cards are shuffled and placed face-down in four rows, 4 cards per row.
2. The player to the left of the dealer selects two cards and turns them up in place.
3. If the cards show a temperature and its logical situation, it is a match, and the layer picks up the two cards and sets them in front of him/her. The turn resumes by picking two more cards. A player's turn continues until two cards which do not match are turned up. If the cards do not match, they are turned face-down in their places and the turn is over.
4. Play proceeds, moving clockwise around the group.
5. The game ends when all cards are used up. The player who has the most cards is the winner.

Teacher Directions/Materials

1. Make the 16 cards, 3 x 2 inches or larger, as shown in the answer key below.
2. Make a directions card and answer key and put them in an envelope with the playing cards. File appropriately.

ANSWER KEY

TEMPERATURE CONCENTRATION CARDS

freezing point	0°C	100°C	
human body temperature	37°C	28°C	
baking cookies	176°C	danger of frostbite	-30°C
room temperature	20°C		-10°C

METRIC TEMPERATURE - POSTTEST

Module 5

Directions: Choose the best answer for each item.

1. A typical temperature for a July day in New York City is

   a) 31° C
   b) 90° C
   c) -5° C

2. A typical temperature for a January day in New York City is

   a) 30° C
   b) 90° C
   c) -5° C

3. A person with a fever might have a temperature of

   a) 38.3° C
   b) 78.2° C
   c) 12.5° C

4. A cake is baked at a temperature of

   a) 17° C
   b) 177° C
   c) 347° C

5. A freezer has a temperature of

   a) -18° C
   b) 18° C
   c) 25° C

6. An air conditioner is set to maintain

   a) 22° C
   b) 52° C
   c) 70° C

7. An average high temperature for Los Angeles in April is

   a) 62° C
   b) 21° C
   c) 89° C

8. The boiling point of water is

   a) 100° C
   b) 212° C
   c) 300° C

9. The freezing point of water is

   a) 30° C
   b) 15° C
   c) 0° C

10. Absolute Zero is

    a) 0° C
    b) -273° C
    c) -500° C

Adapted from Amusements in Developing Metric Skills, p. 39

RELATIONSHIPS WITHIN THE METRIC SYSTEM

Objectives

The participant will be able to:

1. convert from one set of metric units to another using the six basic prefixes and applying them to measurement of length, volume and mass.
2. relate metric length units to area.
3. convert among units of metric length, volume and mass (using water at 4° C. as a standard).

Suggested Activities to Meet Objectives

1. Read and study the narrative on "Relationships within the Metric System."
2. Complete Discussion/Demonstration, "Concepts within the Metric System."
3. Complete Learning Activity #1 on area.
4. Complete Learning Activity #2 on area.
5. Work measurement puzzles on LENGTH, VOLUME, MASS. Complete a practice puzzle before working a 16 square measurement puzzle.
6. Play METRO (Metric Bingo).
7. Complete "Metric Shopping" worksheet.

Illustration of Mastery

1. Completion of "Metric Relationships" posttest with 80 percent accuracy.
2. Agreement of "satisfactory" between participant and instructor on completion of:
    a. Measurement Puzzles (LENGTH, VOLUME, MASS)
    b. Learning Activity #1.
    c. Learning Activity #2
    d. "Metric Shopping" worksheet.
3. Play METRO (Metric Bingo).

RELATIONSHIPS WITHIN THE METRIC SYSTEM

When you have learned the basic metric units of length, volume and mass, you have the basis for every measurement needed in everyday living and in special kinds of work.

Other measuring units are derived from the three basic units and are all interrelated within the metric system. The nicest thing is that they all have simple relationships to each other. They are multiples of 10, 100, or 1,000--the same as in length, mass and volume. This makes calculations extremely simple, requiring only that you move a decimal point to multiply or divide. Mental calculations are easy to do for many relationships, too.

Let's see what these relationships are within the metric system.

Interrelationships of Length

As soon as you learn metric length, you can measure metric area, which is length x width. The meter is the basic length unit, and the square meter is the basic area unit. A square meter is a little bigger than a square yard. Small areas are usually measured by the square centimeter (about 1/2 the area of a postage stamp).

For larger areas, such as land measurement, the common measurement is a square 100 meters on each side or 10,000 square meters. This area unit is called the hectare. You can remember its dimensions because of the hecto-prefix, which means 100. A hectare is about the size of 2 1/2 football fields.

Very large land areas are measured in square kilometers. A square kilometer is 1,000,000 square meters. It is also 100 hectares.

Do you notice how easy it is to divide area into smaller units? A square kilometer divided by 1,000 equals 100 hectares. A hectare divided by 100 equals a square meter. A square meter divided by 10,000 equals a square centimeter. You can divide or multiply simply by moving the decimal point.

Interrelationships Between Length and Volume

You will recall that we previously said the liter was the basic metric volume unit. The liter is derived from a length unit, too. It works like this: If you take a box 10 centimeters long by 10 centimeters wide by 10 centimeters high, you will have a unit that has a volume of 1,000 cubic centimeters. Or 1,000 cubic centimeters is also equal to a cubic decimeter (1 decimeter by 1 decimeter by 1 decimeter). The liter or cubic decimeter is slightly larger than a quart, and convenient for everyday use.

When we want to measure very small volumes, we use cubic centimeters. A cubic centimeter (1 cm long by 1 cm wide by 1 cm high) is equal to 1/1000 of a liter. We call this a milliliter. You will recall that we used this term, too, in earlier study of metric volume. A small sugar cube is slightly bigger than a cubic centimeter.

If we want to measure very large volumes of solid materials such as coal, iron, gravel, cement and soil, we use a larger unit called the cubic meter, which measures 1 meter by 1 meter by 1 meter. A cubic meter is slightly larger than the cubic yard that is in common use in the United States. It equals about 30 bushels.

Interrelationships Between Mass and Volume

Remember that the basic units of mass are the gram and the kilogram (1000 grams). There is an interesting and useful relationship between volume and mass when we use water at 4 degrees C. as a standard. Let's explore this relationship.

One kilogram (1000 grams) of water occupies a volume of 1000 cubic centimeters or 1 liter. Therefore, it follows that 1 gram of water has a volume of 1 cubic centimeter and 1000 kilograms of water have a volume of 1 cubic meter.

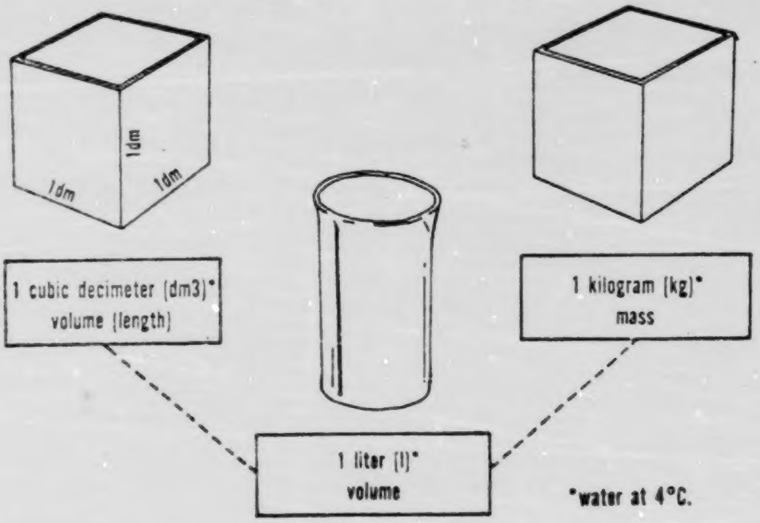
Very large quantities of material are measured by the metric ton, which is 1000 kilograms. One metric ton of water (4° C.) has a volume of one cubic meter.

Interrelationships Among Length, Volume and Mass

In the preceding sections we have discussed the interrelationships between two of the basic measuring units at a time. Perhaps many of you have already figured out that since both length and mass are interrelated to volume, the three basic units have to be interrelated to each other.

One way you can figure this out is illustrated below. The equipment used here includes a liter beaker, a container 1 decimeter x 1 decimeter x 1 decimeter, and balance. When the liter beaker filled with water is poured into the 1 cubic decimeter container, it fills it exactly. When the cubic decimeter container is weighed on the scale, it is balanced by a 1 kilogram mass (the weight of the container must be compensated for).

Thus we found that the contents of the liter exactly fit in the cubic decimeter container. This shows that these two units (the liter and cubic decimeter) are equal for water at 4° C. We also found that the cubic decimeter container of water was balanced by 1 kilogram of mass. That shows that these two units, the cubic decimeter and kilogram, are equal. See diagram below.



In other words: 1 liter = 1 cubic decimeter = 1 kilogram. Therefore 1/1000 of a liter (1 milliliter) = 1/1000 cubic decimeter (1 cubic centimeter) = 1/1000 of a kilogram (1 gram). When you measure in one of the units -- length, volume or mass -- you automatically have the other two. Remember this exact equality relates only to water at 4° C. If you use other liquids than water, they will occupy the same volumes (liter and cubic decimeter) but will have a different mass. Do you have any idea why?

There are many more relationships of units within the metric system when you measure power, light, work, electricity and other energy units. You can learn these terms as you need them in various specialized areas. But you will always find that they have convenient conversions from one unit to another. They will be multiples of 10, 100, 1,000 or even 1,000,000 which are easily calculated by merely moving a decimal point. They will have the same prefixes of milli-, centi-, deci-, deka-, hecto-, and kilo- for identification of their size.

The convenient relationships within the metric system are what make it the most efficient and understandable measuring system in the world. Here are the symbols for the convenient units of area, volume and mass that we have been discussing:

Area Name	Symbol	Volume Name	Symbol	Mass Name	Symbol
square centimeter	cm^2	cubic centimeter	cm^3	gram	g
square decimeter	dm^2	milliliter	ml	kilogram	kg
square meter	m^2	cubic decimeter	dm^3	metric ton	t
hectare	ha	liter	l		
square kilometer	km^2	cubic meter	m3		

Very Large and Very Small Metric Units

The chart above deals with the most common units. As you read more about the metric system you will encounter more units that measure very large or very small amounts. They are multiples of 10, 100 or 1000 and can be quickly calculated by simply moving a decimal point. The following chart will acquaint you with some of these other units.

LARGER UNITS

Prefix Name	Symbol	Definition
tera	T	1 000 000 000 000 (10^{12})
giga	G	1 000 000 000 (10^{9})
mega	M	1 000 000 (10^{6})
kilo	k	1 000 (10^{3})
hecto	h	100 (10^{2})

SMALLER UNITS

Prefix Name	Symbol	Definition
centi	c	.01 (10^{-2})
milli	m	.001 (10^{-3})
micro	u	.000 001 (10^{-6})
nano	n	.000 000 0001 (10^{-9})
pico	p	.000 000 000 001 (10^{-12})

Discussion/
Demonstration

CONCEPTS WITHIN THE METRIC SYSTEM*

1. Review the relationship of metric prefixes to each other by completing the chart below:

*	km	hm	dkm	m	dm	cm	mm
km	*						
hm		*					
dkm			*				
m				*			
dm					*		
cm						*	
mm							*

2. Compare the relationships among the units of the metric system.

   a. Review or explain the concept of area (1 x w = a$[x^2]$).

   b. Review volume (1 x w x h = v$[x^3]$) (transparency).

3. Demonstrate the relationship between the liter and the cubic decimeter.

   a. Use 2 containers, a 1-liter cylinder and a cubic decimeter container.

   b. Fill the cubic decimeter with exactly one liter of water; carefully pour the water from the cubic decimeter into the one-liter cylinder.

   c. Is there more water in the liter or the cubic decimeter? How do they relate to each other?

---

*This session should be led by an instructor.

4. Discuss when to use volume in cubic units and volume in liters.
    a. The teacher gives examples of items measured by volume; the students respond with the type of volume measurement in which the item should be expressed. (e.g. water in milliliters or liters)
    b. Liquids are measured in liters; solids are measured in cubic meters or cubic centimeters.

5. Demonstrate the relationship between length and volume and mass in the metric system.
    a. Weigh the empty cubic decimeter container.
    b. Fill the container with water (4^{o} C).
    c. Weigh the decimeter container filled with water. (Be sure to compensate for the weight of the container.)
    d. How much does the water weigh?
    e. Complete the equation: $1\ dm^3 = 1$ liter = __________ (mass)

6. Discuss the relationship between the cubic centimeter, the milliliter and the gram using water at 4^{o} C as a standard.
    a. If 1 liter of water weighs 1 kilogram, then .001 liter of water would weigh .001 kilogram or 1 gram.
    b. Complete the equation: $1\ cm^3 = 1$ ml = __________

AREA LEARNING ACTIVITY #1

EQUIPMENT NEEDED: scissors, tape, meter stick, cm^2 grid paper

1. Look at your sheet of grid paper (page 67). This used to be identified as 8½ x 11 inches. Estimate its dimensions in square centimeters. 1. _____ x _____

2. Cut out a rectangle (BUT NOT A SQUARE) with an area of 100 cm^2.

   a. Record its area. 2a. ____________

   b. What is its perimeter? 2b. ____________

3. Cut your rectangle (from 2 above) into pieces to make a square decimeter. Tape it together.

   a. Record its area. 3a. ____________

   b. Record its perimeter. 3b. ____________

4. Cut out a square decimeter. Use it to estimate and measure the area of 3 surfaces around the room (e.g., books, desks, tables). Record the measurements.

	Article	Estimate	Measurement
a.			
b.			
c.			

5. Take a meter stick. Identify an object in the room which has a surface of about one square meter. What is it? 5. ____________

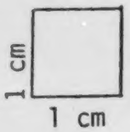
6. Choose a large surface in or near the room (e.g., windows, chalkboard, screen, floor, door, etc.)

   a. What surface did you choose? 6a. ____________

   b. Measure and record its area. 6b. ____________

AREA LEARNING ACTIVITY #2

Area is the measure of a surface. Area can be dealt with in terms of a one-to-one correspondence with the unit of one square centimeter. You should already be familiar with the length of a centimeter. A square centimeter would be:

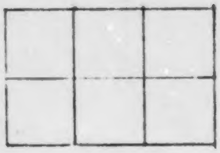


$= 1\ cm^2$

The activities given below are set up so that you can find the area of the figures without knowing the 1 x w = a formula, which requires multiplication. You should be able to make an estimate of the area, then accurately find the area using the a cm ^{2} notation.

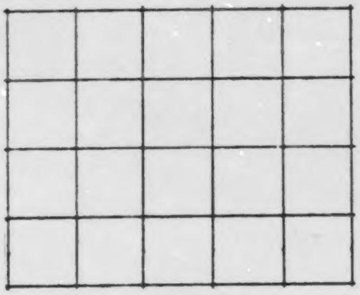
Activity 1: Count the number of square centimeters in the figures below and fill in the blanks. Check the answers.

a.



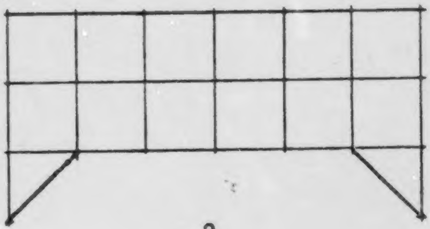
____ cm^2

b.



____ cm^2

c.



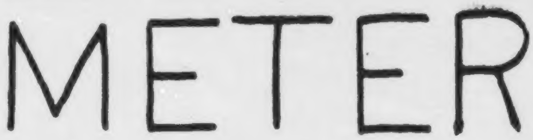
____ cm^2

Activity 2: Cut out figures of the sizes specified below and paste them on a sheet of paper.

a. 20 cm^2 b. 13 cm^2 c. 1 dm^2

Activity 3: Draw around your hand. Estimate the area; now lay the transparent grid over the drawing, and count the number of whole centimeters. Count all parts of a centimeter that are larger than one-half and add them to the total. Total equals ____ cm^2.

Activity 4: Find the area in the word "METER".



Additional Activity: Find the area of the room, playground, etc., in square meters.

MEASUREMENT PUZZLES

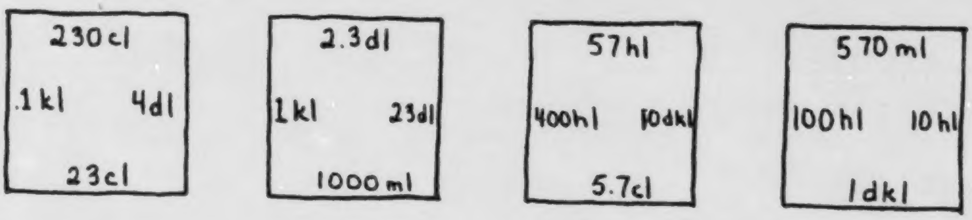
Three puzzles, one each on length, volume and mass, make up this learning activity. For each puzzle, the participant is asked to find the equivalent on each side of each square. The participant is required to complete one of the puzzles, but is encouraged to work all three of them. You may work alone or with someone else. Before starting a puzzle, you are encouraged to complete a "practice puzzle" on length or volume. A description of the practice puzzle on volume is presented below:

Practice Puzzle: Volume

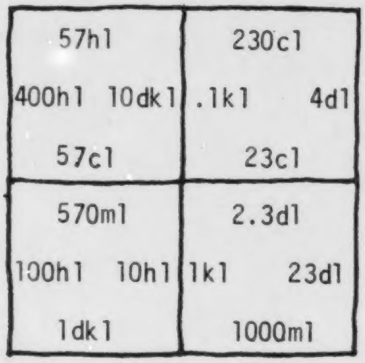
This is a small practice puzzle to use as a warm-up before trying the 16-square ones (length, volume and mass) shown on the following pages.

Arrange the four puzzle pieces (shown below) into one large square so that all adjacent sides name equal volumes.

Here are the puzzle pieces:


230cl
.1kl
4dl
23cl
2.3dl
1kl
23dl
1000ml
57hl
400hl
10dkl
5.7cl
570ml
100hl
10hl
1dkl

When you've finished, the puzzle pieces should be in this order:


57hl
400hl
10dkl
57cl
230cl
.1kl
4dl
23cl
570ml
100hl
10hl
1dkl
2.3dl
1kl
23dl
1000ml

If you completed this practice puzzle correctly, go on to the 16 square puzzles.

LENGTH MEASUREMENT PUZZLE

Cut out the squares. Fit them together so that all adjacent sides name the same lengths. See answer key for correct arrangement.

.057 mm .4 cm .01 mm .023 km	23 m 4 cm 10 dm 57 cm	230 m 400 km 40 hm 57 dm	23 mm 40 m 400 m 5.7 km
570 mm 10 cm .4 mm 230 dkm	57 hm 400 hm 10 dkm .057 cm	57 km .01 m 4 m 23 dkm	230 cm .1 km 4 dm 23 cm
23 hm .04 dkm .04 mm 570 km	570 m 4 km 10 m 2.3 cm	5.7 m .01 mm 400 dm 57 mm	2.3 dm 1 mm 4 mm 57 m
23 km 40 dkm 1 dm 2300 mm	.023 hm 40 dm .1 cm 5.7 hm	5.7 cm .1 mm 40 km 230 km	570 dm 1 dkm 40 mm 230 hm

* Taken from Amusements in Developing Metric Skills; Clack & Leitch,p.10.

VOLUME MEASUREMENT PUZZLE

Cut out the squares. Fit them together so that all adjacent sides name the same volumes. See answer key for correct arrangement.

.56 m^3 3.4 m^3 .034 l 1 ml	.42 ml 340 ml 7 l 56 cm^3	2 m^3 1 cm^3 1 l 42 cm^3	560 ml 60 l 1000 l 2 dm^3
56 ml 2 ml 60 ml .002 l	370 ml 6 l 2000 l 1 m^3	1 cm^3 1 m^3 34 l 2000 l	56 ml 1000 ml 3.4 cm^3 37 l
1000 dm^3 .7 ml 3400 l .56 l	5.6 ml 3.4 ml .6 ml 42 l	37 ml 2000 ml .34 l 1 l	2 cm^3 3400 cm^3 7 ml .0056 l
4.2 l 2 m^3 2 l 560 l	2000 cm^3 70 ml .001 l 3.7 l	5600 ml 34000 ml 3.4 l .056 l	1 dm^3 34 cm^3 2 cm^3 5.6 l

* Taken from Amusements in Developing Metric Skills; Clack& Leitch,p.31.

MASS MEASUREMENT PUZZLE

Cut out the squares. Fit them together so that all adjacent sides name the same masses. See answer keys for correct arrangement.

690 g 1 mg 300 dg 1.2 cg	.02 mg 10 cg 690 kg 1200 g	12 kg .03 t .01 g .03 mg	1.2 kg 30 g 300 kg 69 dg
1.2 dg .3 kg 1 dg .69 kg	6.9 g .1 kg .069 cg .012 t	120 cg .3 cg .003 t .12 kg	120 g 3 cg 3 g .3 mg
12 mg 3 kg 100 g 6.9 kg	.1 mg .069 mg 10 g 69 cg	6900 g 30 dg 30 kg 12 cg	12 g 69 kg 30 mg 120 kg
6.9 cg .3 g .1 cg 1200 mg	690 dg 10 dg 3 mg .012 kg	690 mg .01 mg 3 dg 69 g	.0012 kg 100 dg 300 g 69 mg

* Taken from Amusements in Developing Metric Skills; Clack & Leitch,p.23.

METRO

Objective: To match metric symbols and temperatures with their equivalents.

Directions: (2-6 players) Game is played like Bingo.

1. Each player takes one or more METRO cards. The spaces with words like mass and volume are free and may be covered before the game begins.

2. The caller shuffles the calling cards, then reads the top one, naming both the letter which identified the column and the equivalent measurement (e.g., V - .01 liter).

3. The players find the correct equivalent measurement on their cards and cover them.

4. When a player has covered a complete row--across, down, or diagonally--he or she calls out "METRO". That player then uncovers and reads each of the covered answers while the caller checks to be sure the covered words were correct. If all are correct, the player who called "METRO" is the winner. If the player has made a mistake, play continues until a winner is found.

Teacher Directions/Materials:

1. Make six METRO cards, 7 by 9 inches (See sample below in miniature). Using the data from the chart below, fill the spaces on each card randomly with symbols or temperatures as you would for Bingo cards. Length measurements are placed in the column L, volume under V, mass under M, and temperature under T.

   Two spaces on the card may be used as "free" spaces. They should be in two different columns and written in red. The appropriate word--length, volume, mass or temperature--is written in each free space (See example).

2. Make a set of calling cards. Write the equivalents of the symbols and temperatures in the list below on the side used for calling. Put the symbol or temperature on reverse side to be used for checking after a winner has been indicated.

3. Prepare a directions card and answer key (a copy of the Data List below) and put it in an envelope with the METRO cards and calling cards. File appropriately.

Sample METRO Card

METRO
(Metric Bingo)

L	V	M	T
hm	Volume	kg	100°c
dkm	hl	mass	-30°c
cm	dkl	g	-10°c
mm	cl	dg	37°c

Data List

Symbol	Equivalent	Symbol	Equivalent
km	1,000 meters	kg	1,000 grams
hm	100 meters	hg	10 dekagrams
dkm	.1 hectometer	dkg	.1 hectogram
m	1,000 millimeters	g	10 decigrams
dm	.01 dekameter	dg	10 centigrams
cm	.1 decimeter	cg	10 milligrams
mm	.001 meter	mg	.001 gram
kl	10 hectoliters	0°c	freezing point of water
hl	.1 kiloliters	37°c	human body temperature
dkl	100 deciliters	176°c	baking cookies
l	100 centiliters	20°c	room temperature
dl	10 centiliters	100°c	boiling point of water
cl	.1 deciliter	28°c	good day for swimming
ml	.001 liter	-10°c	skiing weather

METRIC SHOPPING

As a shopper, you probably like to "get the most for your money." Decide which amount of each item below is the largest. Write the letter for the "best buy" in the blank at the right.

1. Breakfast food is about 49¢ for: 1.____________
   a. 500 grams
   b. .49 kilograms
   c. 60 dekagrams

2. Milk is about 55¢ for: 2.____________
   a. 20 deciliters
   b. .2 liters
   c. 200 milliliters

3. A loaf of bread is about 45¢ for: 3.____________
   a. .75 kilograms
   b. 7.5 dekagrams
   c. 700 grams

4. Butter is about 85¢ for: 4.____________
   a. .45 kilograms
   b. 50 grams
   c. 47 dekagrams

5. Jam is about 69¢ for: 5.____________
   a. 170 grams
   b. .18 kilograms
   c. 15 dekagrams

6. Peanut butter is about 96¢ for: 6.____________
   a. .70 kilograms
   b. 5000 centigrams
   c. 750 grams

7. Bacon is about $1.19 for: 7.____________
   a. 50 grams
   b. 5 hectograms
   c. 4.5 dekagrams

8. Orange juice is about 39¢ for: 8.____________
   a. 10 deciliters
   b. 1.2 liters
   c. 1000 milliliters

9. Coffee is about $3.50 for: 9.____________
   a. 1.5 kilograms
   b. 14 hectograms
   c. 1500 decigrams

10. Breakfast sausage is about $1.90 for: 10.____________
    a. 89 dekagrams
    b. .95 hectograms
    c. 900 grams

RELATIONSHIPS WITHIN THE METRIC SYSTEM - POSTTEST Module 6

Metric measurements are given in the first column. In the second column are equivalent measurements. Find an equivalent in the second column to match each measurement in the first column. Put the correct letter in the blank at the left.

________ 1. 250 dl
________ 2. 2.5 g
________ 3. .5 g
________ 4. 500 dkg
________ 5. 25 mg
________ 6. 2.5 l
________ 7. 50 hl
________ 8. 50 m
________ 9. 500 cm
________ 10. 2.5 hm

a. .05 kilometers
b. 50 hectograms
c. 2.5 dekaliters
d. 250 meters
e. 5 kiloliters
f. 50 hectometers
g. 25 decigrams
h. 250 centiliters
i. 50 decimeters
j. 2.5 centigrams
k. 500 milligrams
l. 50 milliliters

The following items relate to water at 4° C.

________ 11. What is the volume in liters of a dm^3?
________ 12. What is the mass of a ml?
________ 13. What is the volume in cubic units of a kg?
________ 14. What is the volume in liters of a kg?
________ 15. What is the volume in cubic units of a g?

METRIC AND ENGLISH RELATIONSHIPS

Module 7

Objectives

The participant will be able to:

1. convert from metric to English units and vice versa in writing and in actual performance in terms of length, volume, mass in
    a. estimated outcomes (e.g., longer, larger, smaller).
    b. accurate conversion in units.

Suggested Activities to Meet Objectives

1. Read "Living in a Metric Conversion World."
2. Study chart on "Metric Conversion Factors" in Appendix D.
3. Complete Learning Activity #1 on "English/Metric Conversion."
4. Play the game METRIC MAID.
5. Play the game METRIC STADIUM BASEBALL.
6. Complete at least two of the following challenge activities:
    a. Convert a school supplies list to metric units. (Learning Activity #2)
    b. Convert the daily weather report to metric units (Learning Activity #3).
    c. Convert punch recipes to metric units (Learning Activity #4).
    d. Revise a pattern into metric units (Learning Activity #5).
    e. Prepare a supermarket shopping list in metric units (Learning Activity #6).
    f. Rescale a baseball diamond and draw the plan in metric units. How far would it be to left field?, right field?, center field?, between bases?, to the pitcher's mound?
    g. Evaluate an everyday experience in metric units. (Learning Activity #7)

Illustration of Mastery

1. Completion of posttest with 80 percent accuracy.
2. Agreement of "satisfactory" between participant and instructor on two or more challenge activities.

LIVING IN A METRIC CONVERSION WORLD

The United States is now changing over to the metric system of measurement, but while the change is going on, we will be living in a world of conversion. You will be using both metric and English units for some measurements for perhaps 10 or 15 years as people become accustomed to the new system.

While this manual has been written to introduce you to the metric system without reference to the English system, it will be necessary in many practical situations to convert units from one system to the other. During the change to the new system, both kinds of units are being used to acquaint people with the equivalence of metric and English measurements. For example, many highway road signs now are posted in both miles and kilometers. Speedometers of cars register speed in kilometers per hour and miles per hour. Some magazines and newspapers express both kinds of units for all measurements. Weather forecasters give temperatures in both Fahrenheit and Celsius degrees.

To aid you in making basic conversions from one system to another, you can use the table of some common units below:

When You Know	Multiply by	To Find
inches	2.5	centimeters
yards	0.9	meters
miles	1.6	kilometers
quarts	0.95	liters
pounds	0.45	kilograms
centimeters	0.4	inches
meters	3.3	feet
kilometers	0.6	miles
liters	1.06	quarts
kilograms	2.2	pounds

Refer to Appendix D for a complete conversion chart.

LEARNING ACTIVITY #1 - ENGLISH/METRIC CONVERSION

1. Measure 3 objects in the classroom or IMC. Record the lengths below in metric units. Then, using the conversion factors, record the English units. To check, measure in English and convert to metric.

Item	Metric	English
1.		
2.		
3.		

2. Weigh 3 objects in the classroom or IMC. (They may be the same or different from the objects used in #1) Record the masses (or weights) as you did in #1.

Item	Metric	English
1.		
2.		
3.		

3. Fill an unmarked beaker with some water (any amount). Find out the volume in all metric units listed below. Then convert it to English units listed below, using the conversion factors. Check it by measuring in English. Then take the temperature of the water in both metric and English units.

Metric	English
____________ ml	______________tsp
____________ cl	______________Tbsp
____________ dl	______________fl oz
____________ l	______________ c
____________ dal	______________pt
____________ hl	______________qt
____________ kl	______________ g

Temperature: _______ °C or _________ °F

METRIC MAID

Objective: The student will be able to match the English measure with the metric measures with 100% accuracy.

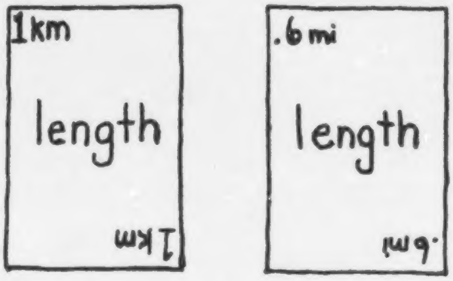
Directions: (2 to 4 players)

1. Dealer shuffles and deals all cards.
2. Players sort their cards and place all pairs together. A pair is the 2 cards that name equal measurements in English and metric (e.g., 1 inch and 2.54 cm).
3. The player to the left of the dealer draws a card from the hand of the player to his or her left. The player then places all pairs of cards on the table face-up. Other players check to be sure all pairs are correct.
4. The next player to the left draws a card from the player on his or her left and places all pairs on the table.
5. The game continues until all cards except the Metric Maid have been matched and placed on the table. The player having the Metric Maid card is the loser. The player with the most cards on the table may be called the winner.

Teacher Directions/Materials

1. Make a deck of 21 - 45 cards as shown in the example:

All cards must be one of a pair except for one odd one, the Metric Maid. Suggested values for pairs of cards are shown below.



These cards would make a match.

The following values are suggested as pairs:

1 km = .6 mi
1 m = 1.1 yd
1 cm = .4 in
1 mm = .04 in

1 kg = 2.2 lbs
1 g = .035 oz

1 mi = 1.6 km
1 yd = .9 m
1 ft = 30 cm
1 in = 2.5 cm

1 lb = .45 kg
1 oz = 28 g

1 gal= 3.8 l
1 qt = .95 l
1 pt = .47 l
1 c = .24 l
1 fl oz = 30 ml
1 Tbs= 15 ml
1 tsp= 5 ml

1 liter = 1.06 qt
1 ml - .03 fl oz

METRIC STADIUM BASEBALL

Objective: The student will be able to give the correct answer to the questions in order to hit a run with 100% accuracy.

Directions: Two teams with from one to four players on each team. It does not matter if there are the same number of players on each team.

1. The game is played very much like a real baseball game, except that the game is only four innings long. Each team gets a maximum of 6 turns at bat (6 questions) in an inning.

2. The four piles of cards are placed face down on the playing table. The team members in the field may take turns asking questions, or they may select a "pitcher" who asks questions for the entire inning. The batter may select a question from any of the four piles.

3. After the batter decides which question level to attempt, the pitcher takes the top card from that pile and reads it aloud. If the batter answers correctly, his/her base runner is advanced. For example, if a double is correctly answered, the advance is to second base. If a question is not answered correctly, an "out" is made. The pitcher should then read the correct answer aloud. Each team gets three outs per inning or a maximum of six turns at bat.

4. Cards with questions that have been asked should be set aside. If any of the piles run out, these cards are shuffled and reused.

5 Each base runner advances the same number of bases as does a successful batter. For example, if there is a runner on second base, and the batter hits a single, the runner on second base may advance only one base. If the batter hits a double, the runner on second base can advance two bases to score a "run."

6. Each team can bat only 6 times per inning. If a team has batted 6 times and still hasn't made three outs, it must take the field, allowing the other team a chance to bat. But any runners left on base may return to their respective bases when their team is at bat again. If a team makes three outs, however, runners left on base cannot return to their bases the next inning.

7. Each team keeps score on the score board, and the team that is ahead at the end of four innings wins the game.

Teacher Directions/Materials:

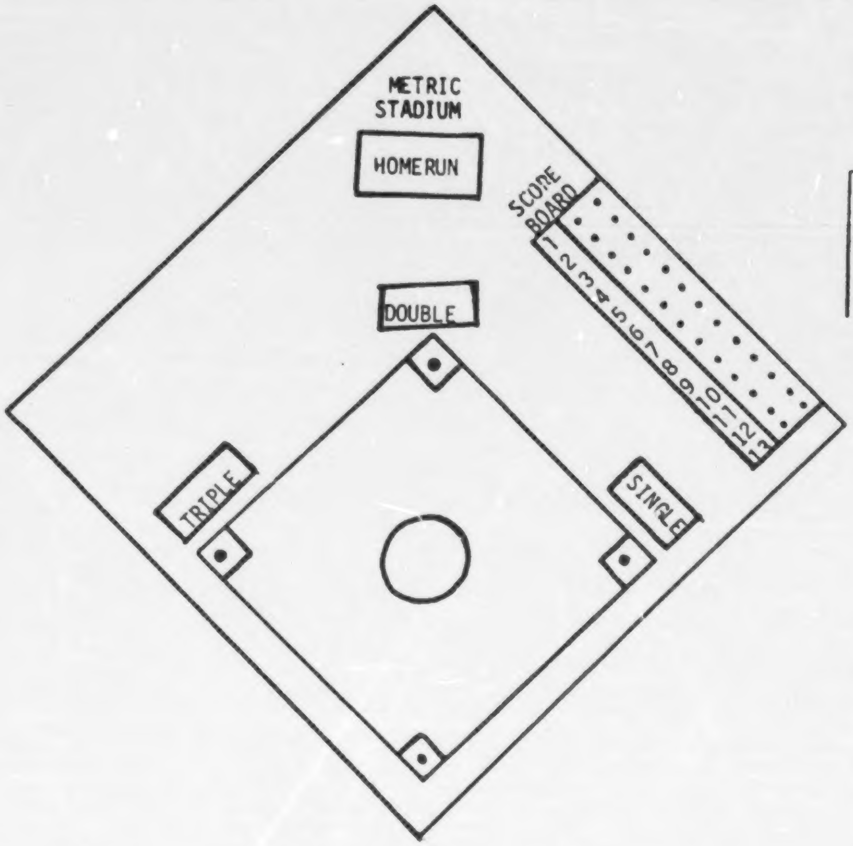
Game Board (see illustration, next page)

Question cards: 4 sets - singles, doubles, triples, homeruns (singles are the easiest questions to answer, doubles a bit harder, and so on; homeruns are the most difficult). Use different color cards for each set to differentiate among singles, doubles, triples, homeruns. Questions may be based just on the metric system or may include metric-English conversions. (See samples on next page).

Extra cards may be inserted in each set, such as: (1) Walk! Go to first base (2) Your fly ball was caught by the center fielder (3) You're OUT!

Golf tees

METRIC STADIUM BASEBALL cont.



Note: All black circles are punched out to hold the golf tee markers.

Sample Card

Single

If a meter is divided into 10 parts, each part is called a ?

(decimeter)

Sample Questions:

Single: 1. How many decimeters are there in a meter?
2. 1,000 meters is called a kilometer; 1,000 grams is called a ____?____

Double: 1. What metric unit of area is about the same as a square yard?
2. At what temperature on the Celsius scale would water boil?

Triple: 1. If a bat is 36 inches long, about how long is it in meters?
2. Your team has a water bucket that holds 12 quarts. About how many liters is that?

Homerun: 1. Which bat would be lighter - one that weighs 4 pounds or one that weighs 12 kilograms?
2. Your team is going to travel 10 kilometers to a neighboring town to play ball. How many miles will you travel?

LEARNING ACTIVITY #2 - ORDERING SUPPLIES

Below is a request for school supplies. The sizes are given in English measuring units. Convert the sizes to metric units and write them in the appropriate column.

(Prepare 2 Copies)

CENTRAL STORES SUPPLIES
REQUISITION

Department Elementary Education

DATE February 13,1975

Account Code Number 102-055

Requested by J. Sorenson

Building and Room Library 1110

Approved by Max Poole

Stock No.	Quantity Requested	Unit	Item Description	English Measure	Metric Measure	
32298	2	ream	Paper, bond, white	8½X11"		
32444	1	roll	Tape, magic mending	3" core		
32427	1	roll	Tape, masking	½" core		
32218	2	bottle	Glue, Elmer's	16 oz.		
32069	1	pkg-100	Cards, Index	3X5"		
32076	5	box	Cement,rubber	4 oz.		
32073	2	pkg-100	Cards, Index	5X8"		
32012	1	box	Bands, rubber	¼ lb.		
32405	1	each	Scissor	8"		
32404	1	each	Ruler	15"		
32146	1	each	Envelopes, brown	9X12"		
32161	3	Box-100	Fasteners, paper	1 ¼"		
32162	2	Box-100	Fasteners, paper	2 "		
32120	1	can	Duplicating fluid	1 Gal.		

Received by Central Stores Supplies

Date February 14,1975

Filled by__________ **Number**__________ **Posted by**__________

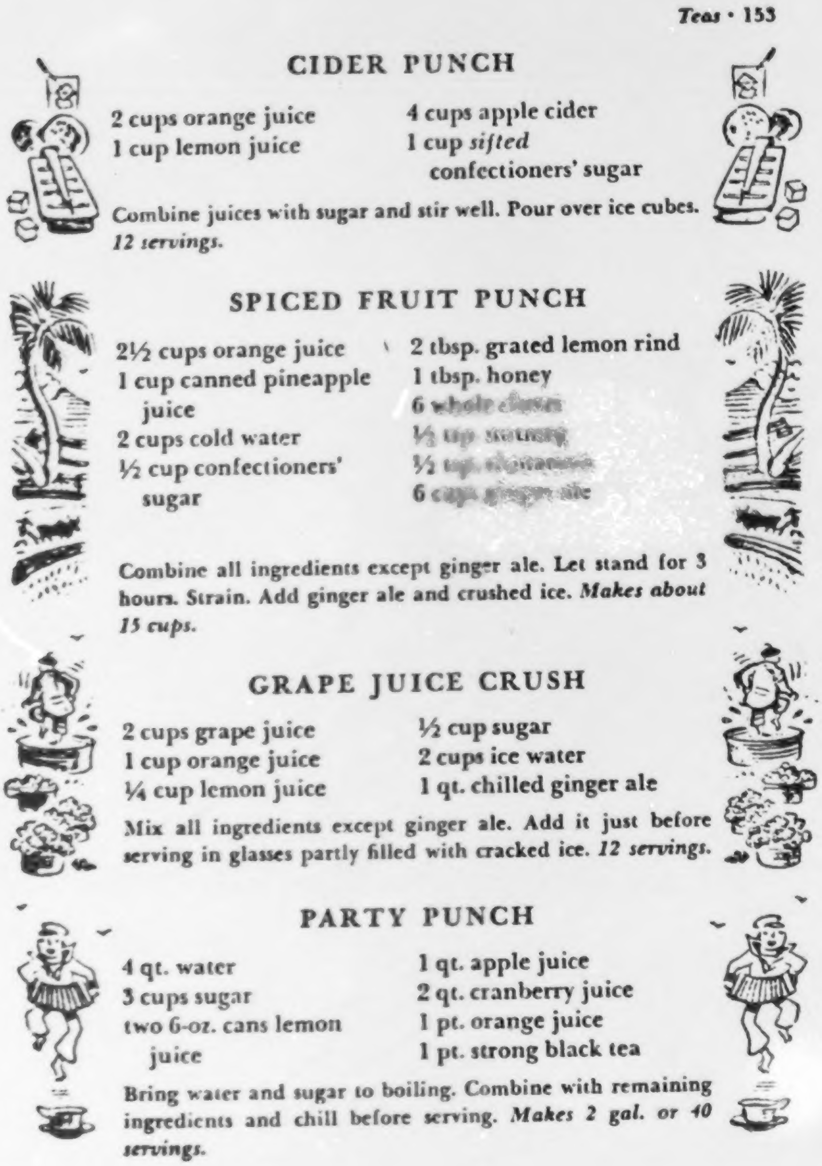
LEARNING ACTIVITY #3 - WEATHER REPORT

The weather information for a day in March is given below. Convert the information into metric units. You may then rewrite the information in paragraph form suitable for reading on the evening news.

English Units	Temperature	Metric Units
44°F	Current	________
49°F	High for the day	________
38°F	Low for the day	________
-21°F	Coldest temperature in the nation	________
87°F	Warmest temperature in the nation	________
35°F	Predicted low for tonight	________
40°F	Predicted high for tomorrow	________
10 mph	Wind Velocity	________
29.74 inches	Barometric Pressure	________
.03 inches	Precipitation	________
3 miles	Visibility	________
2,000 feet	Ceiling	________

LEARNING ACTIVITY #4 - PUNCH RECIPE

Choose one of the punch recipes given below. Convert the quantities to metric units. Rewrite your recipe in the space to the right.



Teas · 153

CIDER PUNCH

2 cups orange juice
1 cup lemon juice
4 cups apple cider
1 cup *sifted* confectioners' sugar

Combine juices with sugar and stir well. Pour over ice cubes. *12 servings.*

SPICED FRUIT PUNCH

2½ cups orange juice
1 cup canned pineapple juice
2 cups cold water
½ cup confectioners' sugar
2 tbsp. grated lemon rind
1 tbsp. honey
6 whole cloves
⅓ tsp. nutmeg
½ tsp. cinnamon
6 cups ginger ale

Combine all ingredients except ginger ale. Let stand for 3 hours. Strain. Add ginger ale and crushed ice. *Makes about 15 cups.*

GRAPE JUICE CRUSH

2 cups grape juice
1 cup orange juice
¼ cup lemon juice
½ cup sugar
2 cups ice water
1 qt. chilled ginger ale

Mix all ingredients except ginger ale. Add it just before serving in glasses partly filled with cracked ice. *12 servings.*

PARTY PUNCH

4 qt. water
3 cups sugar
two 6-oz. cans lemon juice
1 qt. apple juice
2 qt. cranberry juice
1 pt. orange juice
1 pt. strong black tea

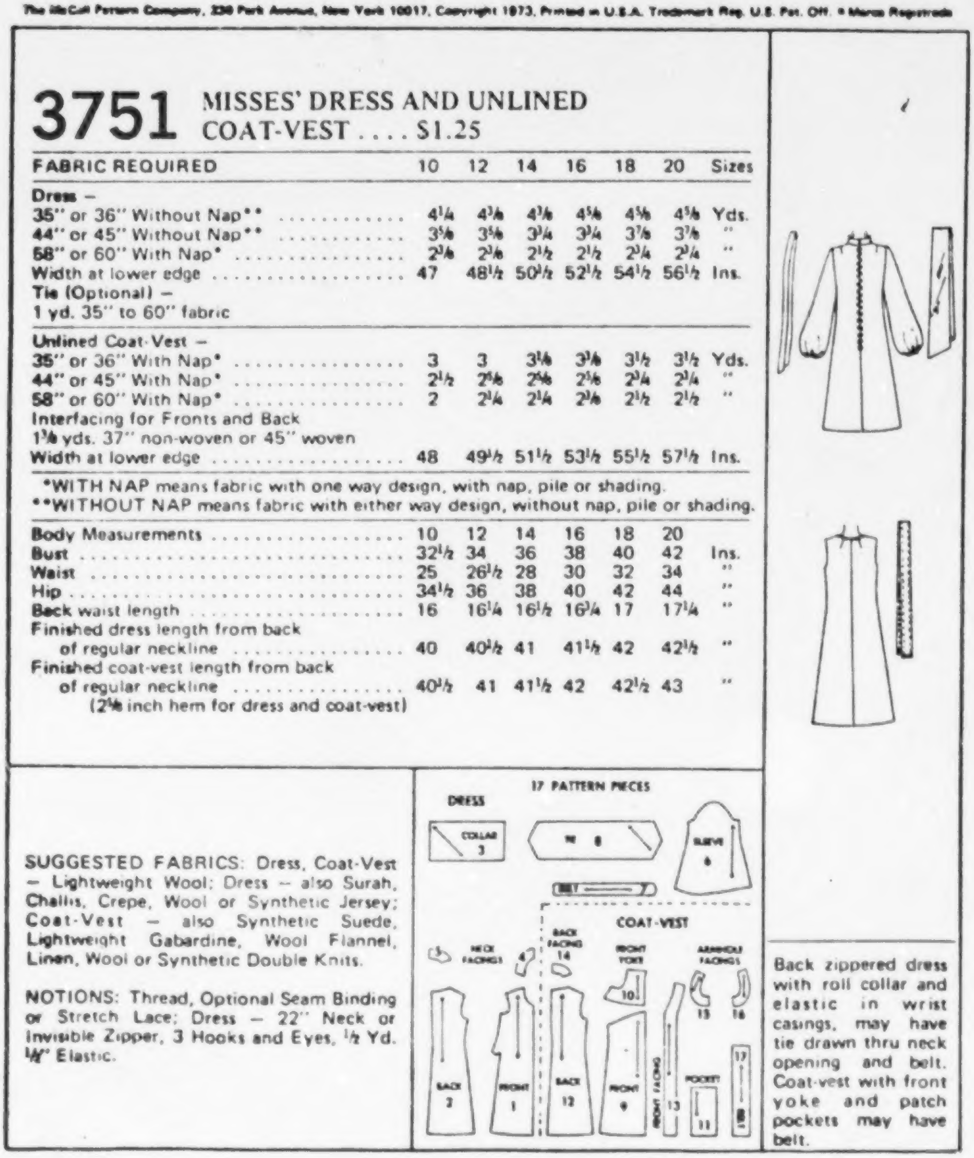
Bring water and sugar to boiling. Combine with remaining ingredients and chill before serving. *Makes 2 gal. or 40 servings.*

Betty Crocker's Guide to Easy Entertaining. New York: Golden Press, 1959.

LEARNING ACTIVITY #5 - PATTERN

On this page you are given the information from the back of a pattern envelope. Choose the size you wish to convert.

1. Find the Body Measurements section. Convert these measurements (for one size) to metric measurements.
2. Using either the dress or the coat-vest, convert (to metric) the fabric widths and the amount of fabric required for each width.
3. Convert the zipper and elastic measurements to metric.



DRESS
COLLAR 3
TIE 8
SLEEVE 6
BELT 7
NECK FACINGS 5 4
BACK 2
FRONT 1
COAT-VEST
BACK FACING 14
FRONT YOKE 10
ARMHOLE FACINGS 15 16
BACK 12
FRONT 9
FRONT FACING 13
POCKET 11
17

The McCall Pattern Company, 230 Park Avenue, New York 10017, Copyright 1973, Printed in U.S.A. Trademark Reg. U.S. Pat. Off. ® Marca Registrada

3751 MISSES' DRESS AND UNLINED COAT-VEST $1.25

FABRIC REQUIRED	10	12	14	16	18	20	Sizes
Dress –							
35" or 36" Without Nap**	4¼	4⅜	4⅜	4⅝	4⅝	4⅝	Yds.
44" or 45" Without Nap**	3⅝	3⅝	3¾	3¾	3⅞	3⅞	"
58" or 60" With Nap*	2⅜	2⅜	2½	2½	2¾	2¾	"
Width at lower edge	47	48½	50½	52½	54½	56½	Ins.
Tie (Optional) – 1 yd. 35" to 60" fabric							
Unlined Coat-Vest –							
35" or 36" With Nap*	3	3	3⅛	3⅜	3½	3½	Yds.
44" or 45" With Nap*	2½	2⅝	2⅝	2⅝	2¾	2¾	"
58" or 60" With Nap*	2	2¼	2¼	2⅜	2½	2½	"
Interfacing for Fronts and Back 1⅜ yds. 37" non-woven or 45" woven							
Width at lower edge	48	49½	51½	53½	55½	57½	Ins.

*WITH NAP means fabric with one way design, with nap, pile or shading.
**WITHOUT NAP means fabric with either way design, without nap, pile or shading.

Body Measurements	10	12	14	16	18	20	
Bust	32½	34	36	38	40	42	Ins.
Waist	25	26½	28	30	32	34	"
Hip	34½	36	38	40	42	44	"
Back waist length	16	16¼	16½	16¾	17	17¼	"
Finished dress length from back of regular neckline	40	40½	41	41½	42	42½	"
Finished coat-vest length from back of regular neckline (2⅝ inch hem for dress and coat-vest)	40½	41	41½	42	42½	43	"

SUGGESTED FABRICS: Dress, Coat-Vest – Lightweight Wool; Dress – also Surah, Challis, Crepe, Wool or Synthetic Jersey; Coat-Vest – also Synthetic Suede, Lightweight Gabardine, Wool Flannel, Linen, Wool or Synthetic Double Knits.

NOTIONS: Thread, Optional Seam Binding or Stretch Lace; Dress – 22" Neck or Invisible Zipper, 3 Hooks and Eyes, ½ Yd. ¼" Elastic.

17 PATTERN PIECES

Back zippered dress with roll collar and elastic in wrist casings, may have tie drawn thru neck opening and belt. Coat-vest with front yoke and patch pockets may have belt.

Size ____________

Body Measurements

Bust ____________

Waist ____________

Hip ____________

Waist Length ________

Dress Length ________

Coat-Vest Length ____

Fabric Widths

35" ____________

44" ____________

58" ____________

Fabric Required

for ____________

Metric Width	Metric Length
________	________
________	________
________	________

Tie ____________

Interfacing ________

LEARNING ACTIVITY #6 - SHOPPING LIST

Listed below is a shopping list for tomorrow's trip to the supermarket. The quantities are given in English units. Convert the quantities into metric units. Record the total quantity in metric units in the column on the right.

	Total Quantity (metric units)
(2) 1 lb. loaves of bread	
1 lb. box of crackers	
3½ lb. roast	
12 oz. bacon	
10 oz. cheddar cheese	
24 oz. cottage cheese	
3 oz. parmesan cheese	
8 oz. sweet pickles	
2 qts. apple juice	
1 gal. milk	
1 stick butter	
1 extra large box of detergent (5 lb. 4 oz.)	
1 quart of orange juice	
3 pounds of chicken	
A 10 inch stalk of celery	

LEARNING ACTIVITY #7 - EVERYDAY METRIC

Several experiences dealing with everyday application of metric measurement are presented below. Complete one or more of them.

1. Collect can labels from supermarket items which have metric and English units on them. Make a chart and list metric and English units, along with a description of the item. (See Learning Activity #1) When you've finished, make a collage from the can labels for display in the classroom area.

2. Use a metric roadmap and plan a vacation route for you and your family. Mark some things you would like to visit and the distances (in kilometers) between them. (Roadmaps available at AAA, Chicago, IL)

3. Olympic track events are measured in meters or kilometers. Find a listing of Olympic events and make a chart of the length (in metric) of the event and the record time or distance.

4. Some of the records listed in the Guiness Book of World Records are given in metric units. Find some of them and share them with the group.

5. Develop a story activity or other project in which you can relate a continuous set of circumstances using metric measurement (e.g., a trip to the supermarket, a track event, a trip, weather report).

6. Imagine the United States was using the metric system today. You turn on your radio and everything is spoken in terms of the metric system. Think of how commercials, weather reports, sports broadcasts, etc. would sound if metric units were used instead of English. Write a 3 to 5 minute radio broadcast. You may tape it on a cassette and present it to the class if you like.

7. Examine the menus from Europe. Take notice of how the measurements of the beverages are listed in metric units. Make a display showing all the different amounts of beverages served, using colored water. You may want to describe your display to the class.

8. Report a baseball or basketball game using only metric measurements.

9. Rethink the events that have happened to you during the day and write them down. Now indicate how many times measurement was involved and which metric units were appropriate to the measurement.

CONVERTING ENGLISH AND METRIC UNITS - POSTTEST

1. _____ If a 12" ruler was marked in centimeters, it would contain:

   a. 24 centimeters
   b. 30 centimeters
   c. 36 centimeters

2. _____ In metric, a 14" pizza would measure:

   a. 28 centimeters
   b. 35 centimeters
   c. 40 centimeters

3. _____ If football fields were measured in meters instead of yards, the length would be:

   a. 100 meters
   b. 90 meters
   c. 75 meters

4. _____ A trip from Chicago, Illinois to New York City would be 840 miles or:

   a. 504 kilometers
   b. 1176 kilometers
   c. 1344 kilometers

5. _____ One centimeter equals:

   a. .7 inches
   b. .4 inches
   c. 2.5 inches

6. _____ One teaspoon equals

   a. 5 milliliters
   b. 15 milliliters
   c. 10 centiliters

7. _____ A recipe calls for 2 tablespoons of milk. In metric units that would be:

   a. 3 centiliters
   b. 15 milliliters
   c. 10 milliliters

8. _____ If you ordered a 25 centiliter glass of pop, you would have about:

   a. one cup
   b. one pint
   c. one quart

9. _____ A Payday candy bar would weigh about:

   a. 35 grams
   b. 35 ounces
   c. 350 grams

10. _____ A 12 ounce can weighs about:

    a. 120 grams
    b. 240 grams
    c. 336 grams

11. _____ One quart equals:

    a. 1.06 liters
    b. .95 liters
    c. 95 milliters

12. _____ A pint of cream contains:

    a. 47 centiliters
    b. .24 liters
    c. 47 milliliters

13. _____ A 250 pound man weighs:

    a. 400 kilograms
    b. 112.5 grams
    c. 112.5 kilograms

14. _____ A gram equals:

    a. .35 ounces
    b. .035 ounces
    c. 28 ounces

15. _____ Which is larger:

    a. 500 kilograms
    b. 1050 pounds
    c. .105 metric tons

16. _____ The only exact measurement, when comparing English amd metric units is:

    a. 1 quart = .95 liters
    b. 1 inch = 1.54 centimeters
    c. 1 kilogram = 2.2 pounds

17. _____ If a Celsius thermometer gave a reading of 25^{o}, it would be about the same as:

    a. 27^{o} F
    b. 77^{o} F
    c. 45^{o} F

18. __________ If a Fahrenheit thermometer read -5°, it would be about the same as:

a) 20° C
b) 9° C
c) -20° C

19. __________ Water freezes at:

a) 0° F
b) 0° C
c) 32° C

20. __________ A gallon of milk would be:

a) larger than 4 liters.
b) smaller than 4 liters.
c) the same as 4 liters.

DEVELOPING A TEACHING PLAN

Module 8

Objectives

The participant will be able, alone or with others, to:

1. develop a plan for teaching metric measurement at the age/grade level at which he/she teaches. The plan will include provision for:
    a. metric content
    b. objectives for the students
    c. assessments (pre and post)
    d. a variety of grouping patterns
    e. a variety of activities and materials

Suggested Activities to Meet Objectives

1. Review modules used to present metric measurement to teachers.
2. Review ideas, activities, materials on display at the workshop and in your local building and/or system and the city media centers.
3. Develop a plan for implementation that includes: (a) objectives "a through e" in objective 1 above: (b) a timeline for implementation and evaluation: (c) an indication of how your plan relates to metric instruction of children at lower and higher age/grade levels than yours; and (d) evaluation and modification of the plan.

    Note: This plan is to be presented in two stages:

    (1) in outline form before starting the project.

    (2) in detailed form (ready to teach from and may include instructional materials) at completion of course.

Illustration of Mastery

The participant will exhibit mastery by:

1. agreement of "satisfactory" between participant and instructor on:
    a. outline of the plan.
    b. detailed plan (may include instructional materials).

ANSWER KEYS FOR TESTS AND WORKSHEETS

MODULE 1

Posttest

1. meter
2. France
3. U. S.
4. liter
5. gram/kg
6. longer
7. smaller
8. metric
9. lighter
10. standard

MODULE 2

"Kite Tails"

1. 4 cm
2. 40 mm
3. 17 cm
4. 50 mm
5. 7.5 cm
6. 3 cm
7. 20 mm
8. 25 mm
9. 1 dm
10. 7 cm

MODULE 2

Pretest

1. e
2. d
3. d
4. b
5. c
6. b
7. d
8a cm
b mm
c hm
d km
e dm
9a 1000
b 100
c 10
d .1
e .01
f .001

MODULE 2

Pretest (cont)

10a less than
b greater than
c greater than
d less than
e less than
11a centimeter
b meter
c kilometer
d millimeter
e meter

MODULE 2

Posttest

1. c
2. b
3. d
4. c
5. e
6. d
7. d
8. d
9. b
10. a
11a 3 cm
b 1/5 km
c 18 cm
d 240 km
12. variable
13a 6 cm
b 4 cm
14a 40 mm
b 20 mm
15. 5 km

MODULE 3

Posttest

1. liter
2. smaller
3. 1000
4. centiliters
5. dekaliter
6. liters
7. 1000
8. 10
9. e
10. a
11. j
12. i
13. h
14. g
15. c

MODULE 4

Posttest

1. gram
2. heavier
3. grams
4. hectogram
5. centigrams
6. kilogram
7. 1000
8. decigrams
9. g
10. e
11. h
12. a
13. j
14. b
15. c

MODULE 5

Posttest

1. a
2. c
3. a
4. b
5. a
6. a
7. b
8. a
9. c
10. b

MODULE 6

"Time-Breakfast"

1. c
2. a
3. a
4. c
5. b
6. c
7. b
8. b
9. a
10. c

MODULE 6

Posttest

1. c
2. g
3. k
4. b
5. j
6. h
7. e
8. a
9. i
10. d
11. 1 liter
12. 1 gram
13. dm^3
14. 1 liter
15. cm^3

MODULE 7

Posttest

1. b
2. b
3. b
4. c
5. b
6. a
7. a
8. a
9. a
10. c
11. b
12. a
13. c
14. b
15. a
16. b
17. b
18. c
19. b
20. b

CROSSWORD PUZZLE ANSWER KEYS

LENGTH

Across:
1. deka
4. millimeter
6. decimeter
8. hundred
9. cm
10. dekameter
11. meterstick
13. shorter
15. length
16. km
17. thousand
18. centi
19. longer
20. deci

Down:
1. dkm
2. yard
3. meter
5. mm
7. centimeter
8. hecto
12. kilometer
14. hectometer

VOLUME

Across:
2. milliliter
3. dekaliter
4. dl
5. kl
7. centiliter
9. hl
10. hectoliter
13. volume
15. ml
16. smaller

Down:
1. quart
2. metric
3. dal
4. deciliter
5. kiloliter
6. deci
8. centi
11. cl
12. larger
14. liters
15. milli

MASS

Across:
1. smaller
3. hg
5. centi
8. **dag**
10. deka
11. kg
13. larger
14. centigram
16. deci
18. meter
21. kilo
22. dekagram
23. cg
24. mass

Down:
2. milligram
3. hectogram
4. liter
6. paperclip
7. mg
9. kilogram
12. dg
15. hecto
17. gram
19. milli
20. decigram

MEASUREMENT PUZZLES - ANSWER KEYS

LENGTH

57 km .01 m 4 m 23 dkm	.023 hm 40 dm .1 cm 5.7 hm	2.3 dm 1 mm 4 mm 57 m	.057 mm .4 cm .01 mm .023 km
230 m 400 km 40 hm 57 dm	570 m 4 km 10 m 2.3 cm	570 dm 1 dkm 40 mm 230 hm	23 m 4 cm 10 dm 57 cm
5.7 m .01 mm 400 dm 57 mm	23 mm 40 m 400 m 5.7 km	23 km 40 dkm 1 dm 2300 mm	570 mm 10 cm .4 mm 230 dkm
5.7 cm .1 mm 40 km 230 km	57 hm 400 hm 10 dkm .057 cm	230 cm .1 km 4 dm 23 cm	23 hm .04 dkm .04 mm 570 km

VOLUME

370 ml 6 l 2000 l 1 m^3	4.2 l 2 m^3 2 l 560 l	37 ml 2000 ml .34 l 1 l	.42 ml 340 ml 7 l 56 cm^3
1000 dm^3 .7 ml 3400 l .56 l	.56 m^3 3.4 m^3 .034 l 1 ml	1 dm^3 34 cm^3 2 cm^3 5.6 l	56 ml 2 ml 60 ml .002 l
560 ml 60 l 1000 l 2 dm^3	1 cm^3 1 m^3 34 l 2000 l	5600 ml 34000 ml 3.4 l .056 l	2 cm^3 3400 cm^3 7 ml .0056 l
2000 cm^3 70 ml .001 l 3.7 l	2 m^3 1 cm^3 1 l 42 cm^3	56 ml 1000 ml 3.4 cm^3 37 l	5.6 ml 3.4 ml .6 ml 42 l

MASS

.1 mg .069 mg 10 g 69 cg	.0012 kg 100 dg 300 g 69 mg	1.2 dg .3 kg 1 dg .69 kg	.02 mg 10 cg 690 kg 1200 g
690 mg .01 kg 3 dg 69 g	6.9 cg .3 g .1 cg 1200 mg	690 g 1 mg 300 dg 1.2 cg	1.2 kg 30 g 300 kg 69 dg
690 dg 10 dg 3 mg .012 kg	120 cg .3 cg .003 t .12 kg	12 mg 3 kg 100 g 6.9 kg	6.9 g .1 kg .069 cg .012 t
12 g 10 kg 30 mg 120 kg	120 g 3 cg 3 g .3 mg	6900 g 30 dg 30 kg 12 cg	12 kg .03 t .01 g .03 mg

REFERENCES, SOURCES, AND EQUIPMENT LISTS

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20. World Book Encyclopedia. Metric System: Weights and Measures. Chicago, Illinois, 1976. (Reprint)

SOURCES OF METRIC EQUIPMENT

Dick Blick
P. O. Box 1267
Galesburg, Ill. 61401
(METRIC-AIDS, equipment)

Denoyer-Geppert
5235 Ravenswood Ave.
Chicago, Ill. 60640
312/561-9200
(A-V materials; equipment)

Houghton Mifflin
1900 South Batavia Ave.
Geneva, Ill. 60134
(print and equipment)

John Wiley & Sons, Inc.
P. O. Box 4192
Grand Central Station
New York, N. Y. 10017
Book: Thinking Metric
by T.F. and M.B. Gilbert

Math-Master
P. O. Box 1911
Big Spring, TX 79720
(equipment)

OHAUS
29 Hanover Road
Florham Park, NJ 07932
(materials; equipment)

Charles E. Merrill Publishing Co.
1300 Alum Creek Dr.
Columbus, Ohio 43216
(METRIKIT)

Science Research Associates, Inc.
259 E. Erie St.
Chicago, Ill. 60611
(Metric Measurement Program, 1-6)

Imperial International Learning Corp.
Box 548
Kankakee, Ill. 60901
(Metric Learning Kit, grades 4-8)

METRIC EQUIPMENT LIST FOR A CLASSROOM*

The list below indicates suggested equipment for a classroom of 25-30 students. An asterisk indicates items where one is usually sufficient for the building. Equipment items are listed under the areas of length, volume, mass and temperature.

AREA	NAME OF ITEM	NUMBER OF ITEM NEEDED
Length	Centimeter ruler (for young children)	10-30
	Meter sticks	6-8
	Tape measures (cm/mm/m)	6-8
	Dekameter (10 meter) tape	1*
	Trundle wheel	1*
	Area grids in cm^2 (transparencies)	2
	Cubic meter (Tinkertoy type)	1*
	Cuisinaire rods (cm, dm, etc.)	50-1000 pieces
	Cubic decimeter - cardboard	1
Volume	Graduates: 25 ml, 50 ml, 100 ml, 250 ml, 500 ml	1 each*
	Beakers: 100 ml, 250 ml, 500 ml	2 each*
	Beaker: 1000 ml (1 liter)	1*
	Liter bottles: 7-Up, Dr. Pepper, etc.	2-3*
	Miscellaneous small containers (e.g., baby food jars, jam jars, peanut butter jar, etc.)	6-8*
Mass	Metric pan balance scale (accurate to .1g)	1*
	Set of weights (1g to 1kg) for scale	1*
	1g cubic centimeters - interlocking	50-1000 pieces
	Miscellaneous objects, 5-1000 grams	6-8*
	Spring scale (1g to 2kg)	1*
	Paper clips, nickels	10-12*
Temperature	Small plastic thermometers	5*
	Accurate Celsius thermometer	1*

*Usually one of a starred item is enough for a school building.

APPENDIX A

SCRIPTS FOR:

METRIC IN MOUSELAND PUPPET SHOW

RADIO TRAFFIC REPORT FOR METRIC CITY

Script for

METRIC IN MOUSELAND

Puppet Show

Narrator: Once upon a time the metric system creeped into Mouseland. I know you're all wondering how this could have come about - well, let's watch and see! The Teacher is Miss Millie Meter; Waldo, Alfie, and Priscilla are students.

Teacher: Good morning class. I would like to take roll call at this time. Waldo Yardmouse, Alphie Footmouse, Priscilla Poundmouse. Good. Everyone is present today, which pleases me very much. Do you know why? Because today we are going to learn about a new way of measuring, using the metric system.

The kind of system we use now is called the English system. It was common many years ago to measure length from the end of your nose to the fingertips of your outstretched arm. But Alphie, do you see where this is very inaccurate? The length of my arm from my nose to the tips of my fingers is a longer measurement than yours would be. So the King declared that the length of his own arm would be the legal measure of length. Thus we have what is known as the "yard".

Priscilla, do you know how we got the "foot"?

Priscilla: Miss Millie Meter, each person measured his or her own foot.

Teacher: No, Priscilla, it wasn't quite that way, but you're close. The measure we know as "foot" was actually the length of the King's own foot. It happened that the King's arm was three times as long as his foot, so the first yard was divided into three feet. The foot was further divided into 12 parts, known as inches. One inch was about equal to the width of a man's thumb.

Waldo, how did we get the gallon?

Waldo: That's easy! The wine jug became the standard for measuring liquid and the measure was called "gallon". For smaller amounts, they divided the jug into quarters, which were called "quarts".

Teacher: Excellent Waldo! Did you know, class, that in many countries outside the U.S., people measure with different tools and measurements. And today we are going to use this system, known as the metric system.

*This is a script for a puppet show. It was written by undergraduate students Joyce/Chicquette/Knoepke/Hauser/Kluever and revised by Schoofs and Hansen, in elementary education to provide motivation when students are starting to study the metric system. The script is presented here as a guide for others to create a puppet show or other creative activity about metric measures.

The country where it started almost 200 years ago is France. Scientists in that country thought that there should be a better measuring standard than the length of a man's arm or the amount of water he could carry on his shoulder.

Now Waldo, would you read the paragraph about the meter?

Waldo: They divided the distance around the Earth into many small parts. Each part they called a "meter", the word which means measurement. You probably have seen a "meter stick" and noticed it is slightly longer than a yard sitck. If you could place meter sticks end to end, 10 million of them would reach from the equator to the North Pole, one-fourth of the way around the Earth.

The meter stick is divided into 100 smaller pieces called centimeters, and each centimeter is about the width of a pencil. This is something like the way the American dollar is divided into 100 cents.

Teacher: Very good! "NOW, WOULD YOU PLEASE GO ON, ALFIE?" (Sing to the tune of "What's it All About, Alfie".)

Alfie: Sure. The French scientists at first measured quantities of liquid in centimeters. A box 10 centimeters high, 10 centimeters wide and 10 centimeters deep would hold an amount of water they called a liter. The paper carton your milk comes in holds about one liter, a little more than a quart. The liter is divided into smaller units called centiliters (1/100th) and milliliters (1/1000th) of a liter.

Teacher: All right, Priscilla, how about finishing up?

Priscilla: The metric measuring unit used to measure mass or weight is called the gram. It is about the weight of a paper clip. Since many things weigh much more than a paper clip, a bigger weight measurement is used called a kilogram or 1,000 grams. A kilogram is about twice as heavy as a pound.

With the three basic metric units - the meter, liter and the kilogram - we can measure everything in the metric system. It is a convenient system and is easier to work with than other systems.

Teacher: All right class, before we start working on actual metric measure, I think we need our milk break.

Mice: (Sing to the tune of "Everything is Coming Up Roses.")

"GET THE MILK, GET THE CHEESE:

I'LL HAVE TWO GRAMS OF CHEESE IF YOU PLEASE."

Teacher: Class, I think you're catching on!

Mice: (Sing to the tune of "Tea for Two".)

"A GRAM FOR YOU, A GRAM FOR ME;

A LITER FOR YOU, A LITER FOR ME."

Teacher: That is enough for our milk break time. Now we are going to do some actual measuring. Let's take our meter sticks and measure the width, in centimeters, of our principal's picture. Does everyone have the meter stick in his or her hand?

Mice: (Sing to the tune of "The Two of Us".)

"THE METER STICK: DA DA DA DA - DA DA DA DA

THE METER STICK . . . ."

Teacher: Now let's get busy because I want to see what your answer is. You may work on this as a group.

(Pause and then ask for answer.)

Mice: Give answer in centimeters.

Teacher: That was very good class. Why don't we weigh ourselves and record our answers in grams.

(Pause while measuring is taking place.)

What did you get, Priscilla?

Priscilla: Gives answers.

Teacher: Who's got something else we could measure?

Waldo: I want to find out how tall I am!

Teacher: Good idea, Waldo! Let's all do that! Did you all find out how tall you are?

Mice: Yea!

Teacher: Great! What do you think of the measures we worked with today?

Mice: (Sing to the tune of "Everything is Coming Up Roses".)

"EVERYTHING IS COMING UP METERS, AND LITERS, AND GRAMS!!!"

Alfie: Why don't we use the metric system in the U.S.?

Teacher: We are starting to, Alfie. Pattern companies are now using the metric system of measurement in addition to the English system. In our hospitals and laboratories everything is measured in meters. liters and grams. Even the grocery stores are starting to sell food that is measured in metric. Start looking at your cereal boxes at home - I'll bet you'll see metric measures on every one of them. Can you think of a way to use metric everyday?

Priscilla: Gas could be sold in liters instead of gallons.

Alfie: Road signs could be measured in kilometers instead of miles.

Teacher: Well class, those were great suggestions! Does anyone have any more questions?

Mice: (Sing to the tune of "Cabaret".)

"WHAT GOOD IS USING THE YARD STICK TODAY

COME JOIN THE METRIC WAY . . ."

Teacher: Waldo, what can you tell us about people who use the metric system?

Waldo: (Sing to the tune of "People".)

"PEOPLE . . . PEOPLE WHO USE METRIC

ARE THE SMARTEST PEOPLE IN THE WORLD."

Priscilla: I've got something!

Teacher: What, Priscilla?

Priscilla: "THIS LAND IS YOUR LAND

THIS LAND IS MY LAND

IT'S MEASURED WITH METRIC;

METER, LITER AND GRAM."

"DO AWAY WITH YARDSTICKS

DO AWAY WITH INCHES

METRIC WAS MADE FOR

YOU AND ME."

(BELL RINGS)

Mice confer over in the corner.

Teacher: What's going on over there?

Mice: Grand Finale

(Sing to the tune of the Mickey Mouse song.)

"MET . . . . . TRY IT, YOU'LL LIKE IT

RIC . . . . . SEE, IT'S EASY TO USE

SYSTEM

METRIC SYSTEM . . . . . METRIC SYSTEM

FOREVER LET US HOLD OUR METERS HIGH . . . . .

NOW IT'S TIME TO SAY GOODBYE TO YARDSTICKS, QUARTS,

AND POUNDS

MET . . . . . WE TRIED IT, WE LIKED IT

RIC . . . . .SEE, YOU'LL LIKE IT TOO,

SYSTEM."

Narrator: "So the mice in Mouseland measured metric happily ever after, and I know when you learn metric--you will, too!"

Script for

RADIO TRAFFIC REPORT FOR METRIC CITY

(Music background--fading out)

Homer: Well, folks, here we are back again for another session of "Going Home with Homer". We hope you're on your way to a relaxing evening, and we're here to make that drive just as pleasant as possible. We'll keep you informed of current conditions--and a few other things we think you'd like to hear about. The time is 4:15 and we leave our studios briefly for our next traffic report. Come in, Sergeant Anderson.

Sergeant Anderson: Hello, everybody, down there on those busy streets and highways. We're flying low--about 600 meters--because of hazy conditions that are limiting our visibility. Traffic is backed up on the interstate 1½ kilometers at Highway 61 because of an accident. Traffic is moving very slowly at about 35 kilometers per hour. At this rate it will take drivers 20 minutes to go the 11 kilometers from this point to the Lincoln Road Interchange.

We can see 35E looking north from here, and it appears that traffic is moving at or near the 88 kilometer per hour limit, and you lucky drivers should be home soon without any problems.

This is Sergeant Nels Anderson turning you back to Homer in the WMTR studio.

Homer: Thanks, Nels. Now here's the AAA road report for the Metric City area for this weekend. The Department of Natural Resources says that all roads in the state are in good driving condition. But watch for fog in the low spots in early morning or for slippery spots from mud or oil in the late afternoon. If you take a drive, AAA reminds you that at 88 kilometers per hour you get 10 kilometers per liter, and a tank of gas should last you all day.

(Music--fade in and fade out)

Homer: The current weather conditions are brought to you by your Esso stations at 25 convenient locations around the city. And say, have you seen those bargains offered this week? Gas at 20 cents per liter, along with useful kitchen premiums. They're giving away a full set of metric measures--from a giant 500 milliliter cup down to a 10 milliliter spoon. In case you've got any of those old cups of mother's still around, this is a good time to make the change. Do it today at your local Esso station. And now the weather.

Present temperature is 15 degrees Celsius, and wind is from the southeast at 12 kilometers per hour. The barometer is at 770 millimeters of mercury and rising slowly. Last night's rainfall was 25 millimeters and the total for the year is now 52 centimeters, just about 10 centimeters below normal. No rain expected tonight, but the low temperature will be 7 to 8 degrees Celsius.

(Music--fade in, fade out)

Homer: Say, here's a few local goodies from the Guinness Book of Records: A resident of Hudson grew a pumpkin this season that was 350 centimeters in circumference and weighed 75 kilograms! And those college students are still acting up. Last night 27 of them packed themselves into a dorm closet to set a new campus record - and you know those closets are small, just 6 cubic meters.

(Woman's voice): This is the week for bargains at your local Foodland stores. Here are some specials:

Chuck steak - $1.59 per half kilo

Whole chickens, average weight 1500 grams, $1.75 per chicken

Orange juice concentrate--75 milliliter cans, 3 for $1.00

Why not come over and see the bargains at the Foodland store near you?

(Music--fade in and fade out)

Homer: And now your up-to-the minute sports report. Today's hero is Andy Carlson who hit his 10th home run--a 150 meter clout into the left field stands. We'll have details of that game along with tennis and horse racing results in a few minutes.

(Music --------fade out)

APPENDIX B

ADDITIONAL METRIC ACTIVITIES AND INFORMATION

This appendix contains additional activities and information that teachers can use with elementary students and to prepare materials for elementary students.

ACTIVITY/INFORMATION TITLE	AGE/METRIC AREA	PAGE
Metric Match	Primary, General	115
Metric Picture Puzzles	Primary, General	115
Metric Monkey's Prefix Puzzler	Primary, Intermediate, General	116
Licorice Length	Primary, Length	116
Metric Graduation Hat	Primary, Length	117
"Gram" Crackers	Upper Primary, Intermediate, Mass and Area	117
Metric Market	Primary, All Metric Units	117
Measure, Measure, Measure	Primary, Length	118
Metric Rope	Primary, Intermediate, Length	119
Decimeter Detectives	Intermediate, Length	119
Metric Volume Pizza	Intermediate, Volume	119
Postal Problems	Intermediate, Mass	120
Traffic Copter Report	Intermediate, All Metric Units	120
Temperature Slide	Intermediate, Temperature	120
Metric Munch	Intermediate, Area	121
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A Metric Valentine	Intermediate, Length	124
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M & M (Marvelous Metric) Cookies	Intermediate, All Units	127
A Red-Letter Day for Pam	Intermediate, All Units	128
Which Is More Likely?	Intermediate, All Units	130
Metric Problem Solving	Intermediate, All Units	131
Met "Trick" Rummy	Intermediate, All Units	132
Making Metric Measure a Pleasure	Intermediate, Songs	134
Introducing the Measure of Length	First Grade - Length	135
Introducing the Measure of Mass	First Grade - Mass	137
Metric System Curriculum: Objectives and General Approach Suggestions	K-6, All Units	139

METRIC MATCH

(Primary, general)

1. Draw "metric match" board as illustrated in the picture. Place metal fasterners on the dots.
2. Attach strings of equal length to each metal fastener in the right hand column. Be sure the strings are long enough to reach all matching pairs.
3. Have students match prefix with number by connecting strings.
4. Provide an answer key on the reverse side of the card.

METRIC MATCH			
milli	•	•	1/10
deci	•	•	1/100
kilo	•	•	1000
hecto	•	•	1/1000
centi	•	•	1/100
deka	•	•	10

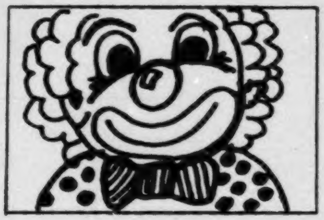
METRIC PICTURE PUZZLES

(Primary, general)

1. Draw a picture on a piece of tagboard and cut it into nine equal pieces.
2. Draw lines on another piece of tagboard, exactly the same size as the first.
3. Put puzzle pieces on top of the whole board and write matching prefix and numbers on back of puzzle piece and corresponding section of tagboard.
4. Students should match the prefix or number on the back of each puzzle piece to the matching word or prefix on puzzle board.
5. If the pieces form a picture when the student is finished, the child has correctly matched the prefixes with the numbers.

hecto	milli	1000
100	1/10	kilo
1/100	deka	10

Puzzle Board



(Front)

100	$\frac{1}{1000}$	kilo
hecto	deci	1000
centi	10	deka

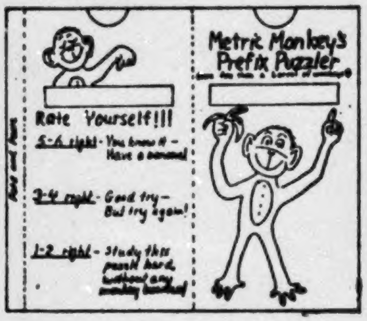
(Back)

Puzzle Answer Sheet

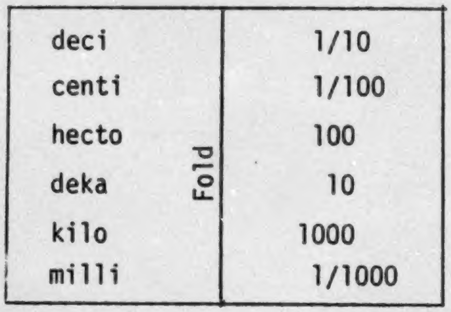
METRIC MONKEY'S PREFIX PUZZLER

(Primary, Intermediate, General)

1. Construct the puzzler as follows:
   - a. Make the outside by enlarging the diagram below on colored paper (construction or lightweight card stock).
   - b. Make the inside as illustrated below so it can be inserted in the outside folder.
   - c. Put the inside in place in the folder and paste the puzzler together.
2. Give a puzzler to each child and have him or her quiz him or herself or others.


Metric Monkey's Prefix Puzzler
Rate Yourself!!!
5-6 right - You know it - Have a banana!
3-4 right - Good try - But try again!
1-2 right - Study this puzzle hard, without any monkey business!

Outside Folder



deci	1/10
centi	1/100
hecto	100
deka	10
kilo	1000
milli	1/1000

Inside

LICORICE LENGTH

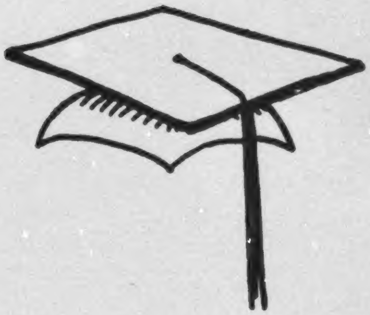
(Primary, length)

1. Give each student a long (30-50 centimeters) strand of string licorice and have him or her measure it.
2. Have students estimate varying lengths by directing them to eat so much licorice, for example: "Eat one decimeter of licorice."
3. Students can then check their estimates by measuring the remaining piece and subtracting that number from the length of the original piece.
4. Have students keep a continuing record from original length through each subtraction.

METRIC GRADUATION HAT

(Primary, Length)

1. As a culminating activity on the metric system, have the students make their own graduation hats.



2. Give each student 2 pieces of construction paper and have them measure and cut a square 3 dm x 3 dm.

3. Hand out tape measures to each student and tell them to measure their heads and then cut a strip of construction paper the circumference of head by 6 cm wide. Tape end of strip together to form the base of the hat.

4. Construct hat by attaching 3 dm x 3 dm square piece to base of hat strip.

5. Measure yarn for tassles and attach to hat.

"GRAM" CRACKERS

(Upper Primary, Intermediate, Mass and Area)

1. Give each student a "gram" (graham) cracker and have him or her weigh it. Provide a sheet to record the answer.

2. Have the student take a small bite and weigh the cracker again. Record answer.

3. As a last activity before eating the entire cracker, have the student take a big bite, weigh the remaining cracker and record the answer.

*4. Have students find the area of the cracker before and after taking bites.

* Use centimeter grid paper to estimate area.

METRIC MARKET

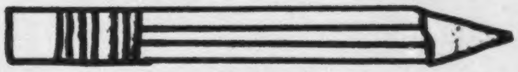
(Primary, All Metric Units)

1. Have each of the students look at home for packaged foods that are labeled with metric units, along with the English units or alone.

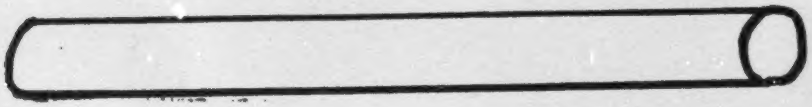
2. When the packages are empty have the students bring them to school. Construct a store out of a refrigerator box to display all of the items. Have the children make up a name for the store such as "DEKA DISCOUNT".

3. Give each child a chance to be the clerk in the store.

How long is each one?



________________ cm



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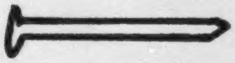

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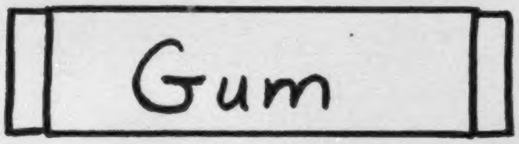

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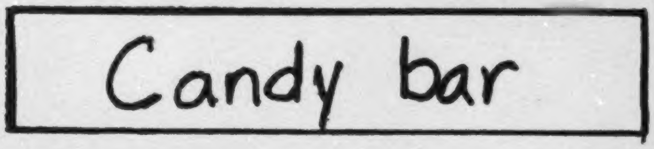

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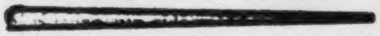

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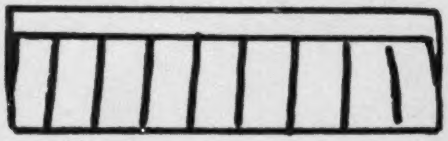

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METRIC ROPE

(Primary, Intermediate, Length)

1. Make a yarn measuring rope by cutting pieces of very heavy yarn or cord of two colors in lengths so each will measure one meter when tied to another piece of the same length. Tie lengths, alternating colors, to make a 10 meter rope (longer if desired).
2. Use the rope to measure distances such as the length of the playground, a city block, or the distances between bases on a baseball diamond. Record five distances that you measure and have someone else check the distance to see if the measurements agree.
3. If you are measuring very long distances, several children with several ropes could work together.

DECIMETER DETECTIVES

(Intermediate, Length)

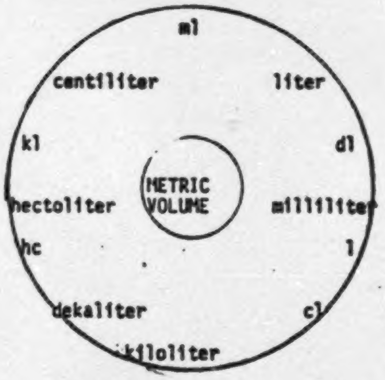
1. Give each student a set of cuisenaire rods.
2. Tape the following instructions on a cassette:

> Pretend you are a detective in metric land. Your mission, if you choose to accept it, will be to discover the various combinations that are needed to make a decimeter. We would like to warn you, however, that you might not need all wooden rods. If you fail in this task you will be banned from the metric detective force. This tape will self destruct in thirty seconds.

METRIC VOLUME PIZZA

(Intermediate, Volume)

1. Make a metric volume pizza game by covering and laminating a 6-inch pizza or other round board.
2. Write metric symbols and names on the board (see picture). Write the reverse symbols or letters on clothespins and match by clipping the clothespin to the word or vice versa.
3. Put the correct answer (e.g., the clothespin for the symbol, ml, is marked milliliter) on the reverse side of the board for self-checking.



POSTAL PROBLEMS (Intermediate, Mass)

1. Stuff 8 to 10 envelopes with different amounts of paper.
2. Obtain a postal or diet gram scale.
3. Develop a chart showing postal rates or obtain one from the post office. For instance, a 25 gram letter would require a thirteen cent stamp, etc.
4. Have the children determine the postal rate for each letter by weighing it.

TRAFFIC COPTER REPORT (Intermediate, All Metric Units)

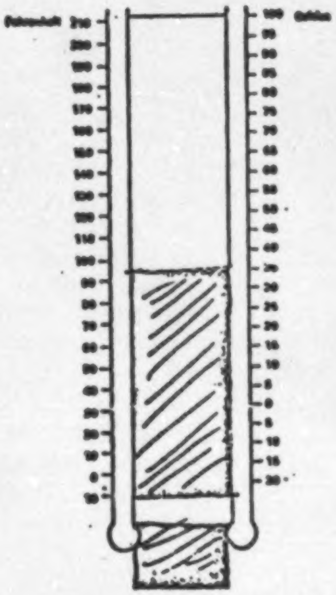
1. Give the students the following instructions:

   Pretend you are reporting traffic conditions from a helicopter over a large city. Report for two to three minutes using metric units whenever measuring units for length, mass, volume and temperature are appropriate. Tape the report and play it for others. Have them determine how many times a metric unit was used.

2. Suggest to the students that they write a script before attempting to record.

TEMPERATURE SLIDE (Intermediate, Temperature)

1. Make the temperature slider (as illustrated) by printing the Celsius and Fahrenheit scales side by side on a strip of tagboard. Leave a two-inch space in between the two thermometers and cut two slits across the top and bottom of this space. Insert another strip of tagboard through these slits. The strip to be inserted should be 2 inches wide and half black and half white.
2. Have the students push their sliders on the thermometer to certain degrees on either scale to find out the equivalent on the other scale. For instance, you could say "Push the slider on the thermometer to 90 degrees Fahrenheit. What is the equivalent temperature on the Celsius scale?"



METRIC MUNCH

(Intermediate, Area)

1. Bring a cake pan of brownies, rice krispies bars, or any other goody to class.
2. Have one child measure the area of the pan in centimeters and have the rest of the class estimate the area of the pan. Compare the estimates with the actual measurement.
3. Have the children determine the area of each piece if they were to divide the pan equally among the entire class.
4. Cut the pan according to the direction of the students and give each a piece.

LINEAR LEAF

(Intermediate, Area)

1. Trace around the edge of various sized leaves and objects. Match a string to the perimeter of the shape and determine the perimeter of the leaf in centimeters by measuring the string.
2. Trace around several leaves on centimeter grid paper and determine the area in square centimeters.
3. Estimate the area of the leaf in square centimeters using the cm^2 grid.

SWEET TOOTH

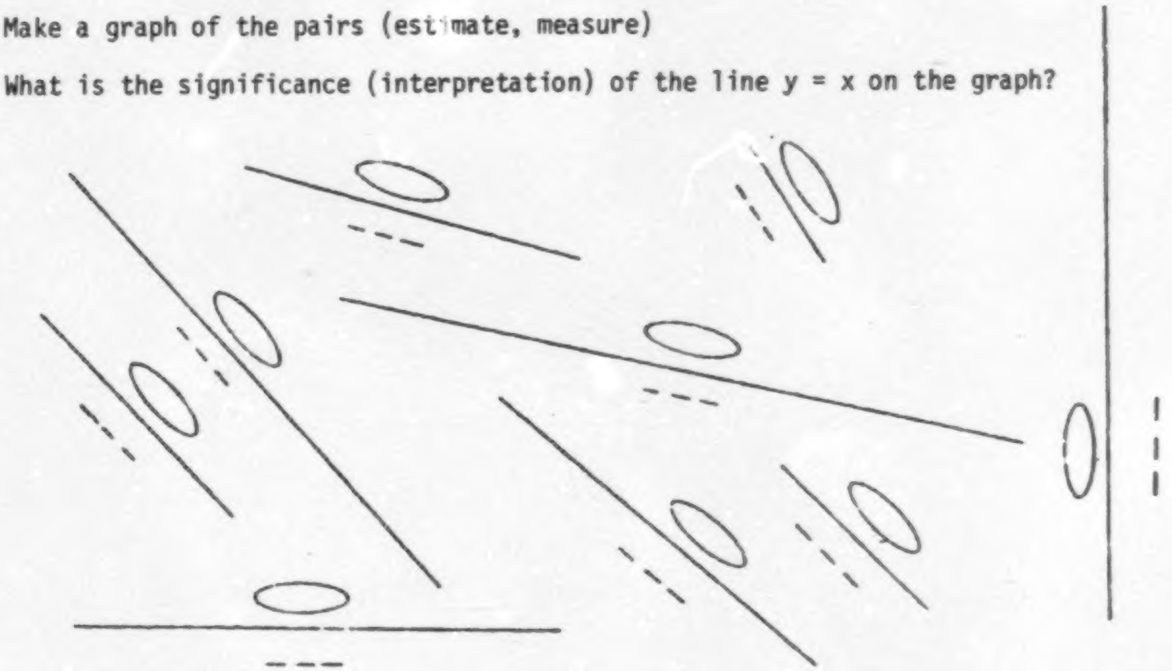
(Intermediate, Area)

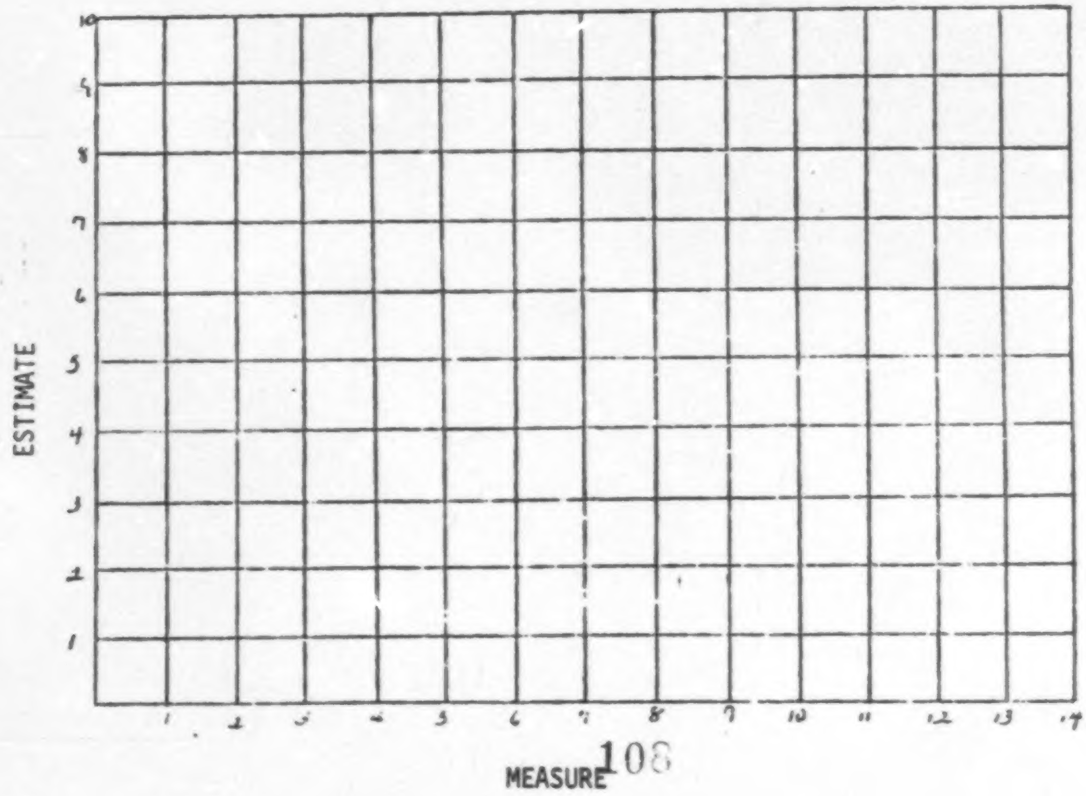
1. Bring sweet objects from home such as doughnuts, cookies and candy bars.
2. Estimate the area of the object.
3. Using the centimeter graph paper (p. 87), place the sweet object on the grid paper and find the area of the object by counting the squares.

Variations: Eat a proportion of the sweet object and find the new area.

ESTIMATE/MEASURE/GRAPH/INTERPRET (Intermediate, Area)

1. Write your estimate of the length in centimeters for each segment in the ⬭
2. Write the measure of each segment on the - - -
3. Make a graph of the pairs (estimate, measure)
4. What is the significance (interpretation) of the line y = x on the graph?

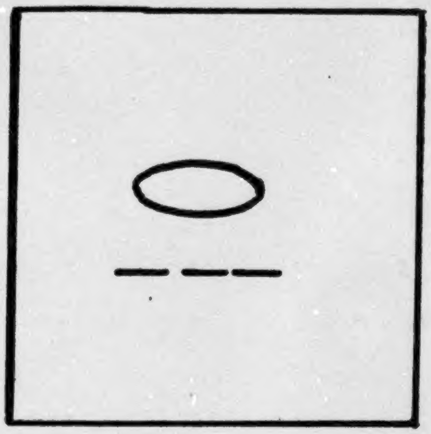


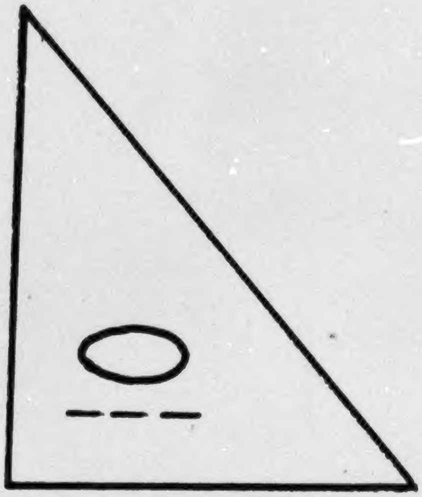


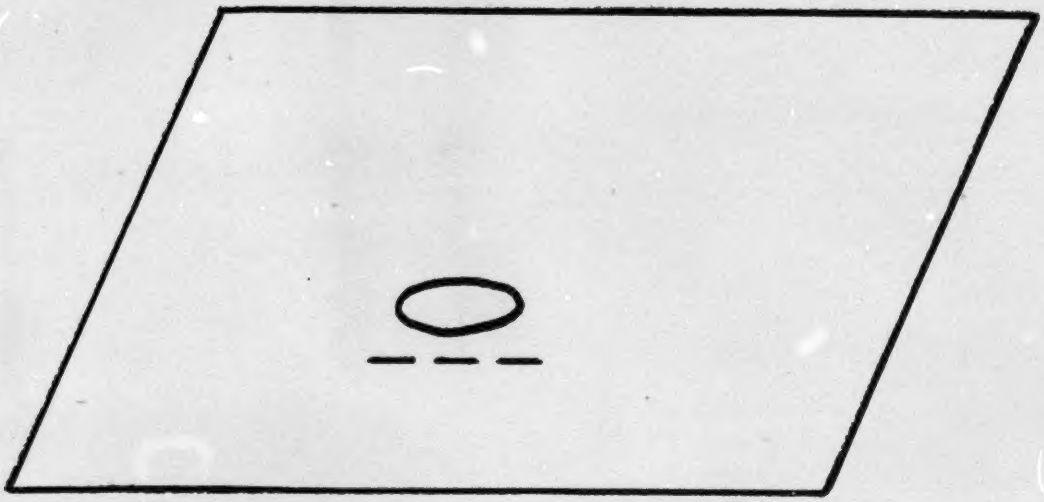
ESTIMATING AREA

(Intermediate, Area)

1. Estimate the area of each polygon in square centimeters ⬭
2. Use your grid to measure the area - - -
3. Determine the difference between ⬭ and - - - and add up the differences.
4. Your team score is the sum of the individual scores.







A METRIC VALENTINE

(Intermediate, Length)

1. Begin at lower left corner of a blank piece of paper. Measure 8 cm to the right and 3 cm. up. Place dot 1 here.

2. From dot 1, measure 3 cm to the right and 2 cm up to locate point 2.

Continue from each dot in the following manner to locate successive numbered dots:

3. right 2 cm; up 2 cm
4. right 1 cm; up 2 cm
5. right 1 cm; up 3 cm
6. up 1 cm
7. left 1 cm; up 2 cm
8. left 2 cm; up 1 cm
9. left 1 cm
10. left 2 cm; down 1 cm
11. left 1 cm; down 2 cm
12. left 1 cm; up 2 cm
13. left 2 cm;up 1 cm
14. left 1 cm
15. left 2 cm; down 1 cm
16. left 1 cm; down 2 cm
17. down 1 cm
18. right 1 cm; down 3 cm
19. right 1 cm; down 2 cm
20. right 2 cm; down 2 cm
21. right 3 cm; down 2 cm

Connect dots in order

METRIC VALENTINE CONT.

A VARIATION

If longer and more varied measurements are desired, all measurements may be made from the lower left corner according to the following scheme.

1. right 8 cm; up 3 cm
2. right 11 cm; up 5 cm
3. right 13 cm; up 7 cm
4. right 14 cm; up 9 cm
5. right 15 cm; up 12 cm
6. right 15 cm; up 13 cm
7. right 14 cm; up 15 cm
8. right 12 cm; up 16 cm
9. right 11 cm; up 16 cm
10. right 9 cm; up 15 cm
11. right 8 cm; up 13 cm
12. right 7 cm; up 15 cm
13. right 5 cm; up 16 cm
14. right 4 cm; up 16 cm
15. right 2 cm; up 15 cm
16. right 1 cm; up 16 cm
17. right 1 cm; up 12 cm
18. right 2 cm; up 9 cm
19. right 3 cm; up 7 cm
20. right 5 cm; up 5 cm
21. right 8 cm; up 3 cm

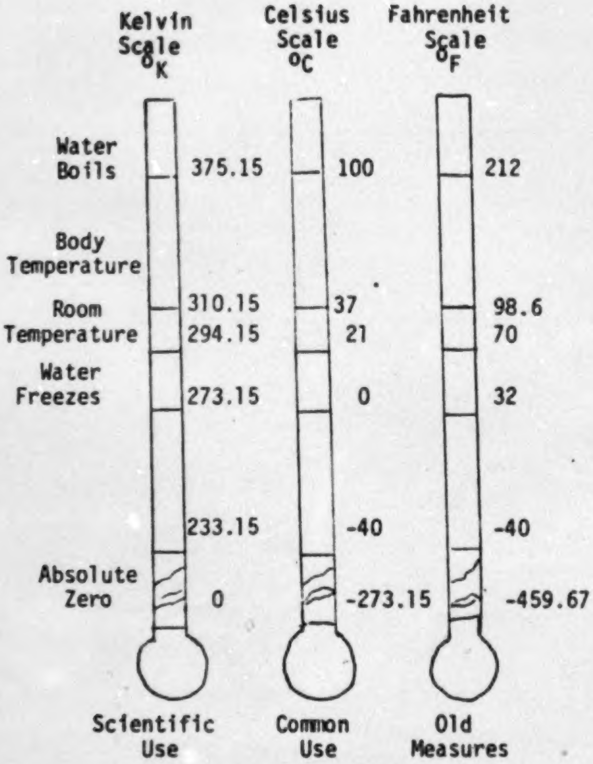
A COMPLICATION

Jumble clues and do not identify picture in advance

A SIMPLIFICATION

Use centimeter grid paper

COMPARING TEMPERATURES* (Intermediate, Temperature)


Kelvin Scale °K
Celsius Scale °C
Fahrenheit Scale °F
Water Boils
375.15
100
212
Body Temperature
310.15
37
98.6
Room Temperature
294.15
21
70
Water Freezes
273.15
0
32
233.15
-40
-40
Absolute Zero
0
-273.15
-459.67
Scientific Use
Common Use
Old Measures

Conversion Formulas

$\text{temp. C} = \frac{\text{temp. F} - 32}{1.8}$

temp. K = temp. C + 273.15

temp. F - 1.8 x temp. 0 + 32

NOTE: The degree Celsius, previously known as Centigrade, and the Kelvin are identical and related by the exact difference of 273.15 degrees.

After you have studied the above thermometers cover them up and see if you can estimate the answer below. Put your answer in Celsius degrees.

________1. Judy was not feeling well so she went to the school nurse. The nurse took her temperature and found that she did have a fever. What would be a likely reading on the thermometer?

________ 2. It had been raining for an hour and then the rain turned to a combination of sleet and snow. School was dismissed early and Henry guessed the temperature to be what?

________ 3. It's early June and you decide it's finally warm enough to go swimming. What temperature would be a likely answer?

________4. Melvin was preparing to go to the football game on the third Friday of November. He put on a heavy jacket, but decided it was not cold enough for a cap or gloves. What is the temperature?

________5. As Jill runs into the house she hears the whistle on the teapot to off. (Thus the water is boiling.) Immediately she pours the water into a cup with a tea bag in it. How hot do you think the water is?

________6. At what degrees is your thermostat set for in the winter at your house?

* Adapted from NCTM materials

M & M (MARVELOUS METRIC) COOKIES

(Intermediate, All Units)

Preheat Oven to 375°

500 ml shortening or butter
375 ml brown sugar
375 ml white sugar
4 eggs
5 ml water
10 ml vanilla
1 l flour
10 ml salt
10 ml baking soda
large bag of M & M's

Cream butter, and sugars. Add eggs, water and vanilla. Combine flour, soda and salt and add to mixture. Stir in M & M's. Drop spoonfuls on cookie sheet and bake for 10 minutes or until golden brown.

KITCHEN METRICS

TABLE OF EQUIVALENTS

2¼ deciliters (dl) = 1 cup liquid

1 cup butter - ½ lb = 225 g

1 cup sugar = 200 g

1 tsp. = 1 coffee spoon

1 Tbsp. = 1 soup spoon

6 2/3 Tbsp. = 1 dl

CHANGE TO THE NEAREST METRIC MEASURE

½ cup milk = __________ dl
2 cups water = __________ dl
1 stick butter (¼ lb.) = __________ g
½ c. sugar = __________ g
3 c. sugar = __________ g

A RED-LETTER DAY FOR PAM * (Intermediate, All Units)

Ten-year-old Pam jumped out of bed, pulled up the shades, and glanced at the thermometer outsider her window. "Oh, what a beautiful June morning!" she exclaimed. "Already the temperature is -1-. (0°C, 21°C, 70°C). What a nice day for Grandma and Grandpa's trip from Chicago to come to see my 4-week-old brother."

She dressed quickly, ran downstairs, poured herself a -2-. (1ℓ, 250 ml, 4 kl) glass of milk, grabbed a roll, and made her way to the nursery where Mother was preparing to bathe her baby brother. "Good morning, Mom! I'm glad I made it to see you take care of Pat this morning."

Mother carefully tested the bath water, and found it to be -3- (10°C, 35°C, 95°C)."I think I'll weigh Pat this morning, so we can tell Grandpa what a big fellow he's getting to be," remarked Mother, as she placed Pam's squirming brother on the baby scale.

"Oh, Mom, he weighs -4- (9 g, 4 kg, 16 mg) already. He is surely gaining fast, because he only weighed -5- (3 kg, 18 g, 150 mg) when you brought him home from the hospital," stated Pam.

"Let's see how much longer he has grown, too," added Mother. Carefully laying him on the bath table, she discovered he was now -6- (55 cm, 3 dm, 1 m) long.

"The way he's growing, I'm sure he'll be -7- (1 m, 2 m, 3 m) tall when he goes to high school. What a center he'll make on the basketball team!" joked Pam. "The way he takes that -8- (250 ml, 1 ℓ, 10 dl) bottle, he must drink at least -9- (5 ℓ, 1 ℓ, 240 ml) a day.

Pam watched intently while Mother bathed and fed Pat, and then put him in his crib for a nap.

Together they went to the kitchen, where they busied themselves preparing lunch. Although Pam helped her mother as much as possible, her thoughts were on the visitors due to arrive soon. "When will they get her? I can't wait much longer," complained the impatient little girl.

"I'm sure they'll be here any minute," replied Mother.

Just then, Pam heard a car pull into the driveway, and she ran out to greet her grandparents. "What took you so long? I thought you'd never get here!" she said.

"Well, you know with that -10- (55 km/hr, 193 km/hr, 88 km/hr) speed limit, it takes about an hour and a half to get here. You know it's about a -11- (1000 m, 120 km, 75 dm) trip from our house up here. And we had to stop and buy -12- (1000 ml, 38 ℓ, 25 dl) of gas, besides," explained Grandpa.

After the proud grandparents had met their new grandson, and had eaten lunch, Pam approached Grandmother with this suggestion, "How about showing me how to make that deliciious chocolate cake of yours?"

---

*Bernice Karow, Wheatland Center School, Burlington, Wisconsin, Grade 5

A RED-LETTER DAY FOR PAM cont.

Grandmother and Pam were soon busy at the kitchen cupboard. "Pam, will you get the baking pan ready, while I get out the ingredients? You will need a rectangular pan that is about -13- (1 m x 5 dm, 8 cm x 12 cm, 22 cm x 30 cm). Pam watched carefully as her grandmother stirred up the cake, using these ingredients:

125 g sugar
75 g butter
1 egg
100 ml milk
100 g flour
2 g salt
2 g baking powder
25 g cocoa

"It needs to be baked at -14- (100° C, 32° F, 160° C) for 20 minutes," Grandmother explained as she slipped the pan into the oven.

The rest of the day passed all too quickly for Pam, as she enjoyed visiting with her favorite grandparents and showing off her new brother to them.

As she went to bed that night, she sighed happily, "This has really been a red-letter day for me!"

A RED-LETTER DAY FOR PAM

ANSWER KEY

1. 21° C
2. 250 ml
3. 35° C
4. 4 kg
5. 4 kg
6. 55 cm
7. 2 m
8. 240 ml
9. 1 liter
10. 88 km/hr
11. 120 km
12. 38 liters
13. 22 cm x 30 cm
14. 160° C

WHICH IS MORE LIKELY? (Intermediate, All Units)

ANSWER BLOCK

1. A man pulls into the service station and says, "Fill 'er up!" Is the attendant more likely to give him 40 liters or 40 milliliters of gasoline? 1.________________

2. Is the height of a classroom closer to 3 meters or 300 meters? 2.________________

3. Would the wheel of a car be closer to 30 centimeters or 30 millimeters for its diameter? (This is a wheel without a tire) 3.________________

4. Suppose you went to the store to purchase a package of bacon. Is it more likely to weigh 5 grams or 500 grams? 4.________________

5. Is the size of a basketball court closer to 350 square meters or 3500 square meters? 5.________________

6. Should the temperature for a nice warm shower be closer to 20° C or 50° C? 6.________________

7. A manufacturer makes a ball bearing to be used in bicycle wheels. Should the diameter of each be closer to 15 millimeters or 15 centimeters? 7.________________

8. Is the distance from Chicago to St. Louis closer to 300 kilometers or 3000 kilometers? 8.________________

9. Would a 1977 Chevy Impala have an engine closer to 80 cubic centimeters or 8000 cubic centimeters? 9.________________

10. Would Minnesota Fats have a waistline closer to 150 centimeters or 1500 centimeters? 10.________________

11. Would the height of a one story building be closer to a dekameter or a decimeter? 11.________________

12. Would a portable typewriter weigh closer to 5 grams or 5 kilograms? 12.________________

13. If you were thirsty, would you be more likely to drink 4 liters of milk or 400 milliliters? 13.________________

14. Your brother is in the Armed Forces and is stationed in Germany. He writes home and tells about his new girlfriend. Would it be more likely for her to weigh 55 kilograms or 110 kilograms. (P.S. Your brother says she could easily pass for a model. 14.________________

15. Your Dad is making a swimming pool in the backyard that will be as deep as your height all the way around. Which is more likely to be the amount of water it will hold? 270 cubic meters or 270 cubic centimeters? 15.________________

16. Is the school football field closer to 1 hectometer long, or 1 kilometer long? 16.________________

METRIC PROBLEM SOLVING (Intermediate, All Units)

Kilograms
liters
meters
Celsius

grams
milliliters
centimeters
decimeters

Fill in the proper units or put in decimal points so these statements are reasonable.

1. A car traveled at an average speed of 965 kilometers per hour.
2. A can of beans massed 311 kilograms.
3. A pop bottle holds 295 ____________________ of pop.
4. The normal body temperature for a boy was 370° Celsius.
5. The speed limit inside the city limits was 563 kilometers per hour.
6. The eighth grade class served an average of 225 kilograms of hamburger per student.
7. The gas tank of the car held 97 _________________ when it was filled.
8. The classroom measured 520 meters by 102 meters.
9. The teacher's desk measured 138 centimeters by 760 centimeters.
10. The tallestboy in the seventh grade class was 178 meters tall.
11. The average weight of the linemen on the football team was 100 kilograms.
12. The liter of milk massed 15 kilograms.
13. The woman bought 183 centimeters of material to make a dress.
14. The chef added 400 grams of salt to the 2 kilogram roast.
15. The cake recipe called for 2 eggs, ________________ milliliters of shortening and 5000 milliliters of flour.
16. The cake was baked at 170 degrees Celsius for 30 minutes.

MET "TRICK" RUMMY

(Intermediate, All Units)

Materials:
1 metric ruler
64 - 6 cm by 10 cm cards (Buy cards in any office supply store.)

Description: There are two kinds of cards: 48 playing cards and 16 suit cards. The playing cards are separated into 4 types (suits). The volume cards test the ability to change from one volume unit to another. Mass cards questions the player's ability to change from one mass unit to another. Length cards test the player's ability to change from one length unit to another. The Centimeter cards test the player's ability to judge distances metrically.

Rule 1: The playing cards are dealt to the players by the one who has been chosen to be the dealer. If 3 players, each receives 16 cards each. If 4 players, each would get 12 cards; and if 6 players, each would get 8 cards.

Rule 2: The dealer then shuffles the 16 suit cards and turns over the top card. This card determines which suit will be played the first time (called the first trick).

Rule 3: The dealer plays one of his cards from the chosen suit, if he has such a card. If he does not have a card of the chosen suit, he can play any other suit. However, he will not win if anyone else has a card of the chosen suit. When the player puts his card on the table, he must tell the other players the value of the card.

Rule 4: After the dealer plays his card, the cards are played clockwise. Each player must play a card of the chosen suit if he has one. If not, he can play any card. As he plays his card, he must tell the value of it.

Rule 5: The player who played the highest valued card of the chosen suit wins the trick. If none of the players had the chosen suit, the winner is the player with the highest valued card of the suit the player who started had. From now on, the player who plays first is called the "opener."

Rule 6: The player who won the trick now turns over another suit card. He then plays this suit if he has any cards of this suit. The winner is chosen as in the first trick.

Rule 7: When a player tells the value of his card, he may be challenged by any other player until the next player plays his card. If the player called the wrong value, the challenger gets to take all the tricks he has accumulated in the game. If the challenger is wrong, the player he challenged gets all of his tricks.

Rule 8: After all the playing cards have been played, the player who has the most tricks wins.

MET "TRICK" RUMMY cont.

Information to be placed on the 48 playing cards:

Volume Suit (12 cards)

1. 1000 cm^3 = ______ ℓ
2. 5000 ml = ______ ℓ
3. 1000 cl = ______ ℓ
4. 500 dl = ______ ℓ
5. 1 ℓ = ______ cl
6. 500 cm^3 = ______ ml
7. 1 ℓ = ______ ml
8. 50 ℓ = ______ cl
9. 1000 ℓ = ______ dl
10. 50 kl = ______ ℓ
11. 1 kl = ______ cl
12. .5 kl = ______ ml

Weight (Mass) Suit (12 cards)

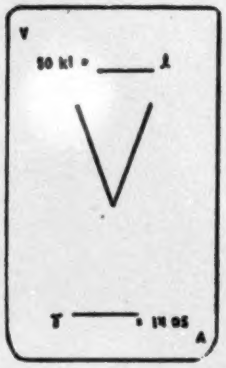
1. 1000 g = ______ kg
2. 5000 mg = ______ g
3. 1 g = ______ dg
4. 50000 mg = ______ g
5. .1 kg = ______ g
6. .5 g = ______ mg
7. 1 g = ______ mg
8. 5 kg = ______ g
9. 100 g = ______ cg
10. 50 g = ______ mg
11. 100 kg = ______ g
12. 500 g = ______ mg

Length Suit (12 cards)

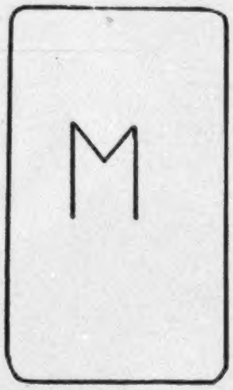
1. 10 mm = ______ cm
2. 500 cm = ______ m
3. 1 cm = ______ mm
4. .5 m = ______ cm
5. 1 m = ______ cm
6. 50 m = ______ dm
7. 1 km = ______ m
8. 50 m = ______ cm
9. 10 m = ______ mm
10. 5 km = ______ dm
11. 10 km = ______ dm
12. .5 km = ______ cm

Centimeter Suit (12 cards)

(Each card will have a line segment or the union of line segments whose measure ranges from 1 cm to 12 cm.)



Sample Playing Card



Sample Suit Card

MAKING METRIC MEASURE A PLEASURE (Intermediate, Songs)

METRIC METRIC

(Tune of Reuben, Reuben)

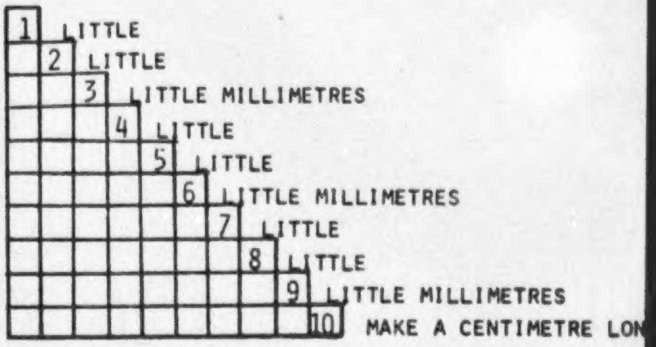
Milli centi deci meter
Deka hecto kilo too.
Put these with the gram and liter
That is all you have to do.

Milli is the smallest measure
10 of these a centi make
100 centi's make a unit
That's not very hard to take.

Kilo means 1000 units
Kilogram 1000 grams.
See how easy to remember.
You can do it if I can.

Jana Tietjen

TEN LITTLE INDIANS


1 LITTLE
2 LITTLE
3 LITTLE MILLIMETRES
4 LITTLE
5 LITTLE
6 LITTLE MILLIMETRES
7 LITTLE
8 LITTLE
9 LITTLE MILLIMETRES
10 MAKE A CENTIMETRE LON

1 LITTLE, 2 LITTLE, 3 LITTLE CENTIMETRES
4 LITTLE, 5 LITTLE, 6 LITTLE CENTIMETRES
7 LITTLE, 8 LITTLE, 9 LITTLE CENTIMETRES
10 MAKE A DECIMETRE LONG!

1 LITTLE, 2 LITTLE, 3 LITTLE DECIMETRES
4 LITTLE, 5 LITTLE, 6 LITTLE DECIMETRES
7 LITTLE, 8 LITTLE, 9 LITTLE DECIMETRES
10 MAKE A METRE LONG!

MISS AMERICA IN THE METRIC SYSTEM

	Height	Bust	Waist	Hips	Weight	Age
Shortest 1921	1.55 m	76.2 cm	63.5 cm	81.3 cm	48.6 kg	16
Tallest 1945	1.78 m	90.2 cm	63.5 cm	88.9 cm	60.8 kg	21
1952	1.78 m	91.4 cm	61.0 cm	91.4 cm	64.4 kg	25
Lightest 1949	1.63	86.4 cm	55.9 cm	86.4 cm	47.7 kg	18
Heaviest 1952	1.78 m	91.4 cm	61.0 cm	91.4 cm	64.4 kg	25

Introducing the Measure of LENGTH to First Grade Children

(First Grade, Length)

Activity #1

Objective - Children will be introduced to definition of measurement and the reason for a standard unit of measure.

Materials - Table
Cardboard box (that will barely fit under table)
meter stick

Procedure - Place the box on the opposite side of the room from the table. Ask the small group of children if the box will fit under the table. After they decide whether or not they think it will fit, have one of the children show the others that the box will fit. If we couldn't move the box, how could we prove that the table is higher than the box? If no one suggests measuring, teacher should suggest it and discuss the meaining of measurement and what might be used to measure the table and the box. Measure the height of the box in cm and the height of the table using the meter stick.

Evaluation - Child will be able to identify a meter stick and that it is marked off in centimeters.

Activity #2

Objective - Child will become acquainted with the reason for using the different units of measurement. (centimeter, decimeter stick, meter stick)

Materials - Centimeter cubes
Decimeter Sticks (not marked off in smaller units)
Meter sticks (not marked off in smaller units)

Procedure - Have two children measure their desks with a cm cube. Have two children measure their desk using a dm stick, and two children using a meter stick. The children should compare their figures. Discussion should follow about why it took more centimeters than decimeters, etc. The necessity of labeling answers with the unit used should also be stressed. The symbol for centimeter should be given to them.

Evaluation - Child will be able to recognize and use the symbol cm.

Introducing length to First Graders cont.

Activity #3

Objective - Child will become acquainted with the cm by measuring objects in the room.

Materials - cm ruler, objects

Procedure - Children will be given a cm ruler and from a list of 10 things choose 5 to measure.

Examples:
- chalk tray
- teacher's desk
- width of doorway opening
- crayon

Evaluation - Given 5 objects, child will accurately measure 3 of them.

Activity #4

Objective - Child will construct lines and shapes of different dimensions with a cm ruler.

Materials - cm ruler, paper

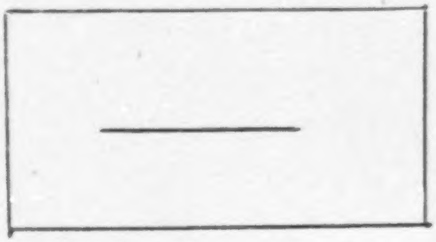
Procedure - Teacher will demonstrate starting point for constructing lines with cm ruler. Child will construct lines of specific lengths. Child will construct shapes with ruler and measure.

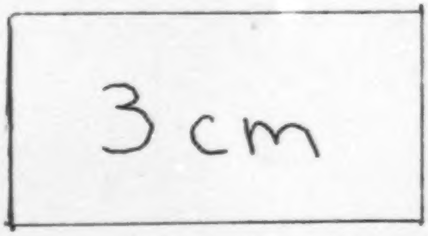
Evaluation - Child will correctly construct 6 out of 8 lines with specific dimensions.

Card Games

25 cards 8 cm x 12 cm

Draw line segments of lengths 1 cm - 10 cm on twelve of the cards. Label the other twelve cards with the dimensions of the lines you drew. The last card should be marked "Wild Card". See example below:





Concentration

Place cards face down in 5 rows of 5 cards each. Two people play the game taking turns turning over two cards. Players must have a cm ruler to measure the line segments. When a player turns up a card with a line segment and a card with the same dimension, he gets to keep the cards. At the end of the game, the player with the most cards wins.

Introducing the Measure of MASS to First Grade Children

Activity #1

Objective - To acquaint the children with the use of a pan balance.

Materials - Pan balance
One group of light objects
One group of heavy materials

Procedure - Choose one object from "light" group and one object from "heavy" group. Put one object on each pan of balance. Is the pan with the heavy object lower? Choose two other objects. Which pan is lower? Change the places of the two objects on the balance. Which pan is lower now?

Evaluation- Children should be able to correctly answer the questions included under procedure.

Activity #2

Objective - Children will be able to estimate which of two objects is the heaviest or the lightest.

Materials - Balance
Assortment of objects (Erasers, sponges, books, paper clips, chalk, small toys.)

Procedure - Point to two objects. Which of the two do you think is heavier? Hold one in each hand. Now which do you think is heavier? Use the balance to see if you're right. Continue with same procedure using different objects.

Evaluation- Child will correctly estimate which is the heavier of 4 out of 5 pairs of objects.

Activity #3

Objective - Children will begin to associate the weight of 1 kilogram with certain objects.

Materials - Balance
1 kg weight

Procedure - Look for an object that you think weighs less than 1 kg. Put the object in one balance and the weight in the other. Was your estimate correct? Find three objects that weigh less than 1 kg.

Evaluation- Given ten objects of which five of the weigh less than 1 kg, the child will be able to correctly choose three of the five.

Activity #4

Objective - Same as objective for Activity #3

Materials - Balance
1 kg weight

Procedure - Look for an object that you think weighs more than 1 kg. Put the object in one balance and the weight in the other. Was your estimate correct? Find three objects that weigh more than 1 kg.

Evaluation- Given ten objects of which five of them weigh more than 1 kg, the child will be able to correctly choose three of the five.

Activity #5

Objective - Same as objective for Activity #3

Materials - Balance
1 kg weight

Procedure - Look for an object that you think weighs 1 kg. Put the object in one balance and the weight in the other. Was your estimate correct? Find three objects that weigh approximately 1 kg.

Evaluation- Given ten objects of which five of them weigh 1 kg, the child will be able to correctly choose three of the five.

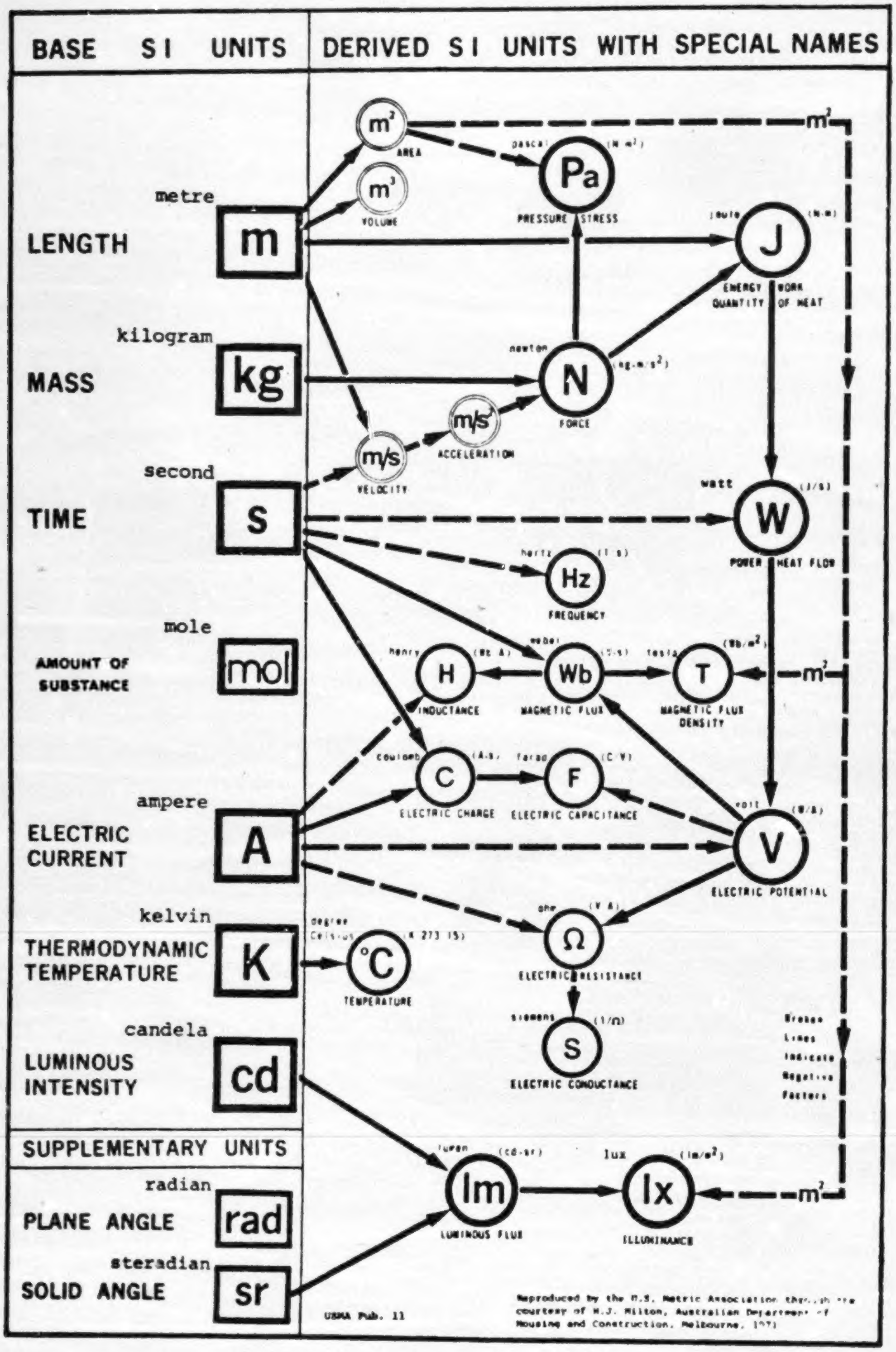
METRIC SYSTEM CURRICULUM - OBJECTIVES AND GENERAL APPROACH SUGGESTIONS

(K-6, All Units)

1. The student should know the place value of digits on both sides of the decimal point and be able to read the number correctly.
2. The student should be able to do the four operations: add, subtract, multiply, and divide, using decimal numbers
3. The student should understand why the United States is changing to the metric system and why this is an easier system to learn and use.
4. Some knowledge of the history of the units of measuring, especially, the derivation of the metric units, should be obtained by the student.
5. The student should know the three base words: meter, liter, and gram (plus their abbreviations), and the six major prefixes (realizing that there are more), and what each means, and their abbreviations.
6. The student should have an idea in his mind as to the size of the common metric units of length, mass, and capacity and, therefore, be able to estimate measures of objects fairly accurately.
7. The student should know how to correctly write metric measures.
8. Given a measure in one unit, the student should be able to change it to the other units of measure by moving the decimal point.
9. The student should be able to read a meter stick and 30 cm ruler and to measure accurately with them.
10. The student should be able to work perimeter and circumference problems using metric measures.
11. The student should be able to find the area of objects having metric measure.
12. The student should be able to find the volume of objects having metric measure.
13. The student should know that the metric system has a relationship which exists between the units of capacity, volume, and mass.
14. The student should be able to change from one unit of area or volume into another unit of area or volume.
15. The student should know how the Fahrenheit, Celsius (Centigrade), and Kelvin temperature scales compare and be familiar with the temperature where water boils and where it freezes, and room and body temperatures in degrees Celsius.
16. The student should be able to do metric word problems in length, mass, capacity, perimeter, circumference, area, volume, and temperature.
17. The student should know how the change to the metric system will affect his everyday life.
18. The student should be able to use inequalities to show relationships between units.
19. By using conversion tables, the student should be able to convert from a unit of length, mass, capacity, and temperature in the metric system to a unit of length, mass, capacity, and temperature in the English system and vice versa.

APPENDIX C

THE INTERNATIONAL SYSTEM OF UNITS (SI)


BASE SI UNITS
DERIVED SI UNITS WITH SPECIAL NAMES
metre
LENGTH
m
kilogram
MASS
kg
second
TIME
s
mole
AMOUNT OF SUBSTANCE
mol
ampere
ELECTRIC CURRENT
A
kelvin
THERMODYNAMIC TEMPERATURE
K
candela
LUMINOUS INTENSITY
cd
SUPPLEMENTARY UNITS
radian
PLANE ANGLE
rad
steradian
SOLID ANGLE
sr
m²
AREA
m³
VOLUME
m²
pascal
(N/m²)
Pa
PRESSURE, STRESS
joule
(N·m)
J
ENERGY, WORK, QUANTITY OF HEAT
newton
N
(kg·m/s²)
FORCE
m/s²
ACCELERATION
m/s
VELOCITY
watt
(J/s)
W
POWER, HEAT FLOW
hertz
(1/s)
Hz
FREQUENCY
henry
(Wb/A)
H
INDUCTANCE
weber
(V·s)
Wb
MAGNETIC FLUX
tesla
(Wb/m²)
T
MAGNETIC FLUX DENSITY
m²
coulomb
(A·s)
C
ELECTRIC CHARGE
farad
(C/V)
F
ELECTRIC CAPACITANCE
volt
(W/A)
V
ELECTRIC POTENTIAL
degree Celsius
(K 273.15)
°C
TEMPERATURE
ohm
(V/A)
Ω
ELECTRIC RESISTANCE
siemens
(1/Ω)
S
ELECTRIC CONDUCTANCE
Broken Lines Indicate Negative Factors
lumen
(cd·sr)
lm
LUMINOUS FLUX
lux
(lm/m²)
lx
ILLUMINANCE
m²

USMA Pub. 11

Reproduced by the U.S. Metric Association through the courtesy of H.J. Milton, Australian Department of Housing and Construction, Melbourne, 1971

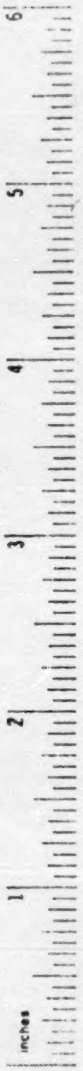
Reference: National Bureau of Standards. Metric Guidelines: Metric Practice Guide and Style Manual, Tarzana, CA 91356, AMJ Publishing Co., 1975.

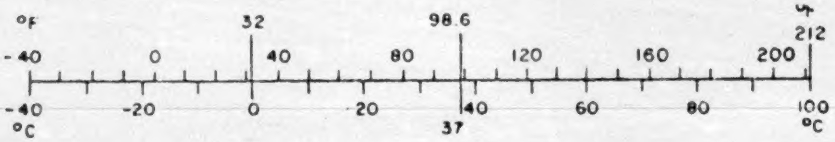
APPENDIX D

METRIC - ENGLISH CONVERSIONS*

Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C





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*1 in = 2.54 cm (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10: 286.

*From NBS Letter Circular 1051, U.S. Department of Commerce, National Bureau of Standards, Washington, D.C. 20231

METRIC-ENGLISH CONVERSIONS cont.

Approximate Conversions from Metric Measures

15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
cm

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (weight)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F

This Letter Circular (LC1051) provides conversion factors for going from the more common customary units to metric units and vice versa. It may be reproduced freely. LC1051 is based on NBS Special Publication 365 (Revised Nov. 1972), "Metric Conversion Card", available by purchase as a wallet-size plasticized card from the U.S. Government Printing Office, Superintendent of Documents, Washington, D.C. 20402. Price 20 cents domestic postpaid, or 10 cents GPO Bookstore. Stock Number 0303-0168. Catalog No. C13.10: 365/2. (25 percent discount on orders of 100 or more copies).